

CHAPTER ONE

MARITIME NETWORKS, CONNECTIVITY, AND MOBILITY IN THE ANCIENT MEDITERRANEAN

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CREATING CONNECTIONS

In an exponentially hyper-connected modern world it is tempting to imagine that the past was a different place, one of sedentary villages in which most people barely ventured beyond familiar confines. Indeed, for Mediterranean prehistory, it is farms and hamlets that dominate the settlement record (Whitelaw 2017, 118). One might, then, easily assume that in such societies most interactions were with family and neighbors, and of a frequency and regularity that made for an almost intuitive communication. In the study of antiquity this perspective is perhaps best encapsulated in Finley's assertion that ancient societies must have operated primarily on a face-to-face basis (Finley 1973). With this notion of the face-to-face, it is all too easy to portray society as static (Moatti 2006; see also Osborne 2011, 217). Mobility becomes an optional add-on, something that might well have happened, but certainly not an inherent societal condition (Clifford 1997).

A strong response to this sedentarist bias emerged in the form of a so-called "mobility turn" that put movement center stage (Clifford 1997; Moatti 2004; Cresswell 2011). What are the implications of a perspective privileging mobility for the study of antiquity? That there was considerable movement in the ancient Mediterranean is hardly in doubt; it is quite clear from written sources and artifact distributions (de Ligt and Tacoma 2016). Furthermore, the sense of it being a precondition for Mediterranean life emerges once one takes into

account the region's heterogeneous environment and unpredictable ecology; it would have been highly beneficial in many cases not to limit oneself to any one ecozone (Woolf 2016; Broodbank 2013). This is a just a general overlay, and over time there would have been diverse motives behind mobility, motives we should no doubt continue to explore. But the more basic question of how mobility was made possible has certainly received insufficient attention. This is a question not only of transportation technology—more on this below—but also of the fundamental conditions enabling communication beyond the face-to-face. For example, Moatti (2006) has identified “translation” as a key process in movement between cultures, and not just in a textual sense. She also describes translation in relation to art, and specifically the “translations” of Greek art in the Roman world. When it comes to the movement of people, the Roman world had various means for assigning identity to migrants, though it was far from categorical; ancient sources tell us that migrants may have carried recommendation letters, or been asked to narrate biographical details, while particular insignias or objects may also have helped establish identity (Moatti 2006; see also Moatti 2004).

For prehistory, we may not have access to the documents that helped establish the identity of a migrant, which in turn could open the door to trust and communication. But the insignias and objects of identity ought not to be completely lost to us. And we need not limit ourselves to such obviously symbolic artifacts. Perhaps it was not only artifacts associated with personal identity that helped establish the conditions for interaction beyond the face-to-face. Might not more prosaic and less personalized artifacts also have provided some of the means for regulating and establishing the basis for interaction? We generally think of artifacts like transport amphoras as impersonal commodities, and as such mere *symptoms* of movement: “material diasporas, the scattering of objects left behind by human vectors,” according to Woolf (2016, 442). But might we not also argue for the infrastructural support provided by things and technologies, themselves variably mobile (Knapp and van Dommelen 2010; Knappett and Kiriati 2016)?

This tension between seeing artifacts as simply a reflection of human movement and exchange relations, on the one hand, and as actively constitutive of social relations, on the other, is played out in the history of archaeological approaches to exchange. The processual archaeology of the 1970s saw attempts to systematize the relationship between the distributions of circulating materials and their underlying social mechanisms (e.g., Renfrew 1975; Sabloff and Lamberg-Karlovsky 1975; Oka and Kusimba 2008), though since then archaeologists have become less certain that any kind of predictable link exists. The idea slowly began to emerge that rather than just being the material outcome of social processes, circulating artifacts may themselves contribute to the formation of social ties across regions, and in turn to the creation of social place.

Ancient historians and archaeologists have introduced considerable theoretical sophistication into studies of space and place in the ancient world, from the domestic space of the household to sacred realms of sanctuaries and vast landscapes of power; in these approaches, the active role of artifacts is pivotal (e.g., Smith 2003; Khatchadourian 2016). Such work is mostly concerned with terrestrial landscapes, however; approaches to analyzing the human geography of *maritime* space and place remain comparatively underdeveloped (though see Knapp and van Dommelen 2010). In general, the sea represents either a flat and featureless plane free to be crossed or a deterministic mix of environmental constraints (winds, currents, visibility, etc.) that essentially predefine a few major vectors of movement and communication.

WE ARE SAILING (OR CANOEING)

Whether we consider maritime connectivity as uniquely enabling or constraining, as offering unparalleled benefit or prohibitive cost, we surely must recognize its uniqueness in circumventing proximity, in collapsing space—and to some extent time—in contexts like the Mediterranean. If the face-to-face basis of interaction is undermined by connectivity, then perhaps maritime mobility offers a particularly dramatic challenge to that principle. Travel overland largely involves a graded movement, such that one culture gives way to another gradually; or an abrupt transition will be marked by some kind of frontier. At sea, such frontiers—to the extent that they actually existed in concept or practice (Rougé 1966, 41–44; Lytle 2012)—cannot be marked, and the unpredictability of maritime movement might throw one upon unexpected shores. These circumstances create more acute challenges for establishing interaction and communication. While maritime research has often focused on the obvious physical constraints enforced by water transport, the sea also influences the development of social bonds centered firmly on maritime rather than terrestrial space. Engagement with seafaring should force us to grapple at once with both the physical and the social factors of mobility.

When we think of the unique benefits of maritime movement that fundamentally distinguish it from terrestrial movement, we might focus on its capacity for fast and reliable longer-distance voyages (noted above) and hence easier and often direct access to exotics of low bulk but high value. Alternatively, its greater transportation capacity for bulky commodities—especially mineral resources, building supplies, and agricultural staples—might serve as the primary driver behind its development. If both motivations are relevant in different conditions, and forms of seaborne exchange are carried out variously over short, medium, and long distances, then what infrastructural and technological considerations come into play for these different kinds of maritime movement? How might persistent patterns of maritime interaction play a role in structuring other

political, social, and economic relations? Does the higher opportunity cost—in technical skill and resource investment—of boats and ships render maritime transport more or less relevant for different individuals, commodities, and mechanisms of exchange? Is there a fundamental distinction between formal connections and “routes” prescribed by those administering exchange and less official geographies derived simply from repeated opportunistic movements and shared experiences among seafarers? And might such seaborne routes persist, exhibiting a form of institutional memory, on the basis of embedded social structures and knowledge, ongoing needs or desires for resources and goods, or simply the continuity of environmental parameters and coastal topography? These and many other broad questions quickly emerge when investigating how maritime interaction shapes past societies, and any such modeling undeniably requires consideration of both environmental and social variables.

When interrogating the interrelated environmental factors and social structures behind Mediterranean maritime activity, a distinction must be made—and here we borrow from Woolf (2016), who draws in turn on Horden and Purcell (2000)—between connectivity as potential or precondition, and mobility as the instantiation and realization of that potential. To reframe some of our questions above, we might ask the degree to which mobility was shaped by the distinctly connective landscape of the maritime Mediterranean world, and thus persistent over time regardless of political and social change. Or were mobilities completely reconfigured in light of changing social conditions? The need to consider connectivity and mobility, environment and society, together is thus obvious, yet there often remains a polarization in approaches to ancient maritime interaction. Archaeologists studying this sphere can become too narrowly focused on particular parameters like winds and currents, harbor and ship technologies. On the other hand, more social approaches to human mobility across the sea can at times be essentially unfettered by such key constraints. It is no accident that this conceptual separation runs parallel to a specialist division between, to put it bluntly, historians and prehistorians respectively. With comparatively few clues offering direct insights into maritime technologies like ships and harbors (Wachsmann 1998), the prehistorian has a limited set of parameters for understanding connectivity. Considerable emphasis is therefore placed on broad environmental conditions and constraints (Morton 2001), which have allowed prehistorians to be among the most active in constructing models focused on connectivity. Yet this lacuna allows, or perhaps forces, more freedom and flexibility for prehistorians in discussions of place. On the other hand, an abundance of technical information on the ships, harbors, and even specialized sails and transport jars can leave a Romanist feeling less compelled to engage with social worlds that inhabited these spaces even though the period was ripe with vivid testimony of individual voyages and patterns of mobility.

Such a picture of separation is, of course, a caricature, particularly for the Mediterranean that forms the focus of this volume.¹ In this region a number of pivotal studies have had a global impact on the scholarly treatment of maritime space. Fernand Braudel's *La Méditerranée et le monde méditerranéen à l'époque de Philippe II* (1949) was transformative in promoting the sea as an integral factor in structuring the awareness and experience of past Mediterranean populations, followed by Peregrine Horden and Nicholas Purcell's *The Corrupting Sea* (2000), and recently joined by Cyprian Broodbank's *The Making of the Middle Sea* (2013). Along with other important contributions (e.g., Sherratt and Sherratt 1993; Harris 2005; Abulafia 2011; Tartaron 2013), these serve to create a more nuanced perspective on how ancient communities viewed, experienced, and exploited maritime space for different social, economic, and political goals. In the eastern Mediterranean, for example, scholars have recognized that some large islands like Crete and Cyprus function effectively as "miniature continents" (Brun 1996; Rackham and Moody 1996; Cadogan et al. 2012), while some continental landmasses like the Peloponnese are almost archipelagic. We should not minimize the interwoven environmental and socioeconomic constraints—including a remarkably heterogeneous resource landscape and fragmented "micro-ecologies" on the one hand, and diverse communities with varied consumer needs, interests, and institutions on the other—that framed maritime connectivity and promoted seaborne mobility for communication and exchange. Both island-studded and with an "inside-out geography" (Horden and Purcell 2000)—water surrounded by land rather than vice versa—the Mediterranean nudged its coastal populations toward the sea as an obvious topography of interaction and recourse for livelihoods. Yet patterns of mobility in either direction from the coast, both across the sea and inland, contributed vitally to the development of community identities in shared social space. That the sea was not only a source of immense potential but one laden with uncertainty and even great risk is evident in coastal raiding and the resulting fear of seaborne visitors, the fortunes and lives lost to a sea capable of sudden transformation into a tempest; the tragic refugee plight reminds us of the ongoing precariousness of maritime mobility even into the modern Mediterranean. Despite important advances in how to approach such a heterogeneous space, scholarship still struggles to create the sorts of meaningful dialogue between specialists of different periods that are so essential. We certainly do not wish to project the notion of a "Great Divide" discussed nearly four decades ago (Renfrew 1980), but significant gaps do remain between different scholarly traditions.

Some of these differences, as noted above, are more the product of the contrasting forms of evidence at our disposal than of any profound epistemological split. For the broadly historic context of the Greco-Roman period onward, scholars are able to consult a number of sources that offer quite direct

testimony to patterns and structures of maritime activity. Texts encompassing a wide range of topics and written for a host of purposes—*periploi* and geographies, poetic narratives, historical sources, epigraphic inventories—can offer indirect, and occasionally direct, evidence (e.g., Arnaud 2005). Of course, *direct archaeological* evidence for actual sea routes, ephemeral by their nature, in the densely interconnected Mediterranean is hard to find, posing particular challenges for the study of human interaction (e.g., Rice 2016). To the extent that prescribed routes ever existed, they are largely invisible, possibly arising and persisting over generations only from tradition, marine knowledge, technology, opportunities, and hazards (Pomey 1997; Andreau and Virlovet 2002; Arnaud 2014). To some extent there may be fewer significant “sunk costs” for sea travel than in overland transport and communication, where infrastructure aggregates over time as roads and passes remain in use well beyond an initial investment (Laurence 1999). Communication by sea can be undertaken from widely varying maritime installations, some as simple as unadorned and only seasonally protected sandy beaches, yet certain forms of interaction may only be practical with built all-season harbors that (if well attended) can represent long-lived installations and landscape features (Marriner and Morhange 2007; Oleson and Hohlfelder 2011). Shipwrecks provide another critical and increasingly abundant source of data in the form of artifact movements, particularly when cargos of transport amphoras or other durable goods are sufficiently diagnostic to ascertain origins (e.g., Parker 1992; 2008). Even so, identifying the origin of a cargo object is hardly the same as understanding the origin of a cargo, and the ultimate destinations of such wrecks can only rarely be discerned with any precision or confidence. Ceramics, anchors, and other objects that gradually accumulate at architecturally invisible anchorages, opportunistic ports, or other points of casual maritime activity among individuals or groups may likewise provide underutilized evidence for evaluating patterns of maritime connectivity and the inscription of distinctive social words on coastal and sea space (Ilves 2009; 2011; Leidwanger 2013; 2018). The adoption of maritime cultural landscape studies, originally a feature of Scandinavian archaeology but now more widely incorporated in both historic and prehistoric contexts in the Mediterranean, has helped to remedy some of this dichotomy (Ford 2011). The landscape approach to long-term patterns of maritime and coastal activity has broadened the traditional focus of such studies, in effect embracing the full material and nonmaterial record for connectivity and mobility: rock carvings, mooring devices, portages, canals, shipyards, ship types, landing sites, beliefs, ritual, mythology, folklore, symbolism, and the like (Westerdahl 1992; 2010; 2011).

Yet this relative abundance of Mediterranean material and historical evidence has perhaps encouraged descriptive approaches of connectivity tied to physical geography that have sometimes inhibited the development of more

social explorations of maritime mobility and the formation of place. After all, when it comes to prehistory, what can we say *directly* and *securely* about Neolithic or Bronze Age seafaring in the Mediterranean? From the Bronze Age Aegean, for example, we have only a tiny number of shipwrecks, with at best a couple that may be slightly earlier than the Late Bronze Age and certainly none that can comfortably inform pre-Bronze Age models. To this we might add a handful of contexts where boats are depicted; mostly stylized renderings serving purposes generally unknown but certainly other than our own, these need not be especially accurate or representative (Basch 1987; Wachsmann 1998; Strasser 2010). The contrast is therefore quite pronounced with the Roman period, where far more direct evidence is available: hundreds of shipwrecks surveyed or excavated (Parker 1992; McCormick et al. 2013; Strauss 2013), scores of larger and smaller harbors, and numerous literary and iconographic portrayals of ships from a variety of contexts (Rougé 1966; Casson 1995). Arnaud's (2005) comprehensive study of the seaborne routes documented in the surviving sources for the Roman Mediterranean is a particularly strong case study in what can be done to promote a holistic view of the structure of maritime activity for one crucial period from just the historical, literary, and epigraphic record. This is not to say that prehistorians have not problematized maritime interaction in their period; it is simply a reflection that the theme has, by necessity, been tackled primarily indirectly, by focusing more on *connectivity* than on *mobility*. One powerful example is provided by Broodbank's (2000) landmark work on the Early Bronze Age (EBA) Cyclades. Armed with a very small number of boat depictions and a generally limited range and resolution of archaeological data (i.e., site size and location, artifact imports), he used basic network analysis to model some likely interaction patterns between islands and to explore how the location and centrality of certain sites may have arisen from these dynamics. This is a rather uncommon example not only of recognizing in principle and acknowledging the paramount importance of specifically maritime connectivity, but also of structuring a formal inquiry around such marine dynamics despite the limited evidence available. For other prehistoric periods where we have significant maritime mobility, like the Middle and Late Bronze Ages, similar investigations have been thin on the ground (see early work on Delos and centrality in Davis 1982, and recent analysis of Mycenaean interaction in Tartaron 2013).

This observation suggests that the fundamental dilemma in addressing questions of maritime connectivity and mobility across the Mediterranean is primarily one of method. The brilliant but rare syntheses of huge datasets into convincing narratives can inspire the field but can also leave the wider swath of scholarship in their wake. It is one thing to appreciate the success of well-constructed and well-analyzed case studies of maritime mobility, but quite another to derive detailed methods and implement them more broadly against a

long-term backdrop of connectivity across periods and increasingly complex bodies of material and other evidence. How can scholars effectively pursue similar fundamental maritime questions for other periods, regions, and datasets? Broodbank's seminal Aegean study was inspired by similar use of proximal-point analysis in another archipelagic setting, Oceania (e.g., Terrell 1977; Hage and Harary 1991; 1996). The success of such network methods inspired one of us (CK) to employ a similar approach to later periods of the Bronze Age in the Aegean, stimulating a long-term collaboration far beyond the traditional disciplinary boundaries to engage with particle physicists (e.g., Knappett, Evans, and Rivers 2008; 2011; Evans, Knappett, and Rivers 2009; Rivers, Knappett, and Evans 2013; Rivers, Evans, and Knappett 2016). Notwithstanding certain earlier applications in archaeology more broadly (for reviews, see Knappett 2011; Brughmans 2013), Broodbank's was a pioneering example of the successful application of formal network analysis to a maritime problem, particularly for the Mediterranean. Broad network metaphors had long been employed in discussions of early trade and interaction ("trade routes," "hubs," etc.), but rapid advances from the social and physical sciences regarding formal network analysis over the past ten to fifteen years (e.g., Newman, Barabási, and Watts 2006) have offered new opportunities for engaging systematically with the breadth and dynamism of structures of socioeconomic interaction within complex societies. The practical impact of network thinking is evident in the boom that began in the mid- to late 2000s and continues apace. Classical archaeology may at times appear behind the vanguard of innovative methodological approaches compared to other branches of the discipline, but this field too has been quite active in the uptake of network approaches drawing from complexity science as well as social network analysis (SNA) (e.g., Graham 2006; Isaksen 2008; Larson 2013).

One of the central aims of the present volume is therefore to advance this trend in the maritime realm, to promote network thinking broadly across the distinctive problems and potential of maritime themes within the Mediterranean. Several important reasons lead us to believe that networks can provide a strong methodological common ground where both prehistorians and historians can productively tread. First, networks allow for a conceptual starting point in either physical or social space. For example, one can begin with a spatial distribution of artifacts (as one tends to find archaeologically) or a set of attested social interactions (as might be described in texts). Though network analysis has not always prioritized combining these two facets, they can indeed help us bridge the persistent gap noted above between the physical and the social. Second, networks encompass a wide range of approaches from which one might choose. This in turn creates its own new challenges that must be addressed explicitly, but it also underscores how the generally flexible network framework can accommodate both data-poor and data-rich scenarios as described above. For example,

if a prehistorian aims to model some most likely interactions across a certain space, it is entirely feasible to do so with only minimal inclusion of data beyond basic details of site location. Similarly, if a Roman archaeologist has masses of data on quantities, types, and co-occurrences of amphoras, then this too can be addressed through the same basic network approach, albeit with certain modifications to account for numbers and variability in the dataset. This flexibility within a single overall method is likely to be a significant factor in the long-term success or otherwise of network approaches in archaeology and history; these are evidently already seeing significant use and adaptation across a broad range of global contexts, from the American Southwest to the North Sea,² a phenomenon underscored by the final commentary by Mills, which aims to contextualize further the central contributions to the present volume. As a methodological lynchpin, networks can accommodate a broad range of epistemological positions, from the humanistic network metaphors of Constantakopoulou (2007) or Malkin (2011) to the more formal scientific approaches of Evans or Rivers (this volume; see also Knappett 2016). To rephrase these strengths in terms of our prior discussion, network approaches allow us to bridge connectivity (as network potential) and specific patterns of human mobility.

A DEEP HISTORY OF MEDITERRANEAN MARITIME INTERACTION?

By adopting a specifically network approach to the archaeological and historical evidence for seaborne communication and exchange in the Mediterranean world, this volume examines the predominant model of maritime connectivity with analytical tools that can shed light on continuity and discontinuity of mobilities across periods and areas. What long-term and interregional trajectories can we identify in the networks that guided movement, communication, and exchange? The Mediterranean offers an unparalleled diachronic case study for maritime network structures across millennia from before the Neolithic up to the early modern era; here our focus is squarely on the pivotal period extending from the Bronze Age into the early medieval world, though many of the themes and perspectives have much broader temporal and spatial relevance. The region has attracted much large-scale multi-period research, focused, however, predominantly on environmental angles (e.g., Vita-Finzi 1969; van der Leeuw 1998; Leveau et al. 1999; Grove and Rackham 2001; Butzer 2011). What is sorely needed now is the fuller integration of different social variables as active agents, which in turn bring their own challenges as scholars attempt to bridge multiple disciplines, principally archaeology, Classics, and history.

Drawing together a range of experience among researchers in these allied fields, the contributions collected here advance network approaches to maritime connectivity and mobility in the ancient world. In particular, we aim to

promote applications of diverse network thinking as well as methodologies that investigate the motives, behaviors, and experiences of seaborne movement and exchange by proposing and testing specific models of the Mediterranean archaeological and historical record (see also Leidwanger et al. 2014). The rapid growth in the size and availability of complex datasets in recent years—including databases of primary maritime material evidence for ancient shipwrecks and ports³—challenges us to employ new management and analysis tools that will allow us to capitalize on these earlier investments in data collection. Network methodologies offer the opportunity to maximize the utility of the multifaceted and often uneven archaeological and historical evidence in a systematic and measurable way (e.g., Preiser-Kapeller 2015).

Moreover, this volume aims, where possible, to bridge what are traditionally viewed as transitional junctures between periods, regions, cultures, and disciplines: for example, between the end of the Bronze Age and the Iron Age, from the late classical era to the international Hellenistic world and the rise of the Roman Empire, and across the dissolution of the Roman state in the early medieval west and its resurgence in the late antique east. Under what conditions do maritime networks manifest a form of “memory,” continuing to inform movement through the physical and social landscape despite significant political and cultural change? As needs of exchange and interaction shift over time, to what extent should we expect to see resilience and continuity in the patterns of maritime mobility? When do networks, by contrast, change on their own or to fit new sociopolitical realities? Do significant changes in maritime technology, such as the innovation and widespread adoption of the sail between the late 4th and the 3rd millennium, correspond to new networks? When basic seafaring technologies remain essentially unchanged—as seems to be the case from the Hellenistic into the Roman world—should we expect resilience and robustness in the nodes and links of maritime networks, even in the face of shifting supply and demand as well as evolving political and other institutions?

A necessary concern therefore centers on the notion of institutional “memory” in Mediterranean maritime networks. Are there entanglements and locked-in trajectories of such a kind that, once connections are firmly rooted, it takes an extraordinary event or rupture to destabilize or even de-establish them? To understand late Roman networks, then, would one need to understand how their sea routes were inherited from earlier Roman and Hellenistic traditions? Would evaluating this in turn require projection back to the classical and Archaic periods, and perhaps even beyond? Early Iron Age exchange networks themselves may not have represented entire reinventions, but rather piggybacked on certain residues of pre-existing maritime structures from the end of the Bronze Age. One could obviously continue back eventually to the Neolithic and perhaps even earlier. This is no doubt an extreme example, but

given the persistence of many of the essential environmental and ecological parameters of connectivity, might significant continuities have crossed some of these critical transitions? Or were networks constantly reinvented time and again according to changing socially constructed variables from technologies to products and markets?

This question brings to the fore a critical second issue related to how we balance our models of interaction between “routes” on the one hand and “Brownian motion” on the other. The former we can imagine as prescribed and perhaps institutionalized, but hardly the latter. It is worth comparing this situation and looking for possible parallels with that between regular and random networks, a dichotomy that was only mathematically overcome two decades ago with a landmark paper defining “small-world” networks (Watts and Strogatz 1998). Should we not, then, be able to conceive of some synthesis or intermediary model between these two forms of interaction? In a Mediterranean world with such diverse mechanisms of exchange as attested for the Roman era, can we model some elements through more formal routes while imagining other seaborne activity more closely paralleling the random background noise of Brownian motion? A modern historical example might suffice to demonstrate the intriguing dilemma, for which we draw on research by John Leonard (2005, 716–740). With the arrival of British rule on Cyprus came new administration of ports and an attempt, particularly in the early decades of the 20th century, to centralize maritime distribution around the several improved harbors at larger coastal centers. The reaction of the local sailors—including those involved in the long-standing carob trade—was swift and indignant. Many continued to use their traditional makeshift ports to transport goods not only among the island’s smaller and larger harbors, but also between the island and the neighboring mainland. Many elements of this traditional maritime network persisted, much to the dismay of the British authorities. Documented in the official records, their efforts continually emphasize the suppression of such activity, which now fell formally under the rubric of smuggling, and the tightening of their grip on customs duties and flow of goods to wider Mediterranean markets. If one network model cannot reasonably fit all situations—something that should hardly come as a surprise given the discussion above about diversity within the material evidence—should the particular pattern depend on the nature of the objects or individuals moving (elite or everyday) or perhaps the geographical distances being traversed?

The notion of multiple maritime operational scales, whether complementary or contrasting, presents a third area of necessary concern. Should we envision a series of structurally similar but nested networks, from the local to the global? Is it critical, or even beneficial, to work simultaneously across all scales in an effort to understand a complex and geographically expansive

phenomenon like Greek colonization or Roman commerce? If one works only at a macro scale, does the sea just become an undifferentiated expanse that fails to reveal the remarkable variation and nuance evident in the ways humans experienced and exploited maritime space? In our efforts to address the complexity of “social” maritime space, we cannot lose sight of the complexity of its physical space, its undeniable topographical and environmental variability as well as its heterogeneity in the spatial allotment of resources. We must recall the differential geographical behavior cited above, wherein large islands have the capacity to function conceptually or practically like “miniature continents” while peninsulas or other continental landmasses assume an insular identity. Rather than rigidly framing maritime connectivity, environmental realities can themselves become secondary, subsumed under socioeconomic considerations. The island-studded and distinctly “inside-out” geographies noted previously point to the possible advantages afforded by such opportunistic maritime landscapes and underscore the need to address each at its own regional scale, yet any coherent synthesis of Mediterranean maritime networks must at once look up and down and across these scales.

Alongside these issues of analytical scale we should raise a fourth obvious question: where should an individual shipwreck cargo fit? From a spatial-network perspective of maritime exchange, these sites take on an absolutely fundamental importance as direct evidence for mobility, for connectivity in action, but they also present pronounced methodological difficulties (e.g., Greene this volume; Leidwanger 2017). Approaching shipwrecks simply as “mobile nodes” would seem to present a certain dilemma in that they hardly represent the logical equivalent of settlements or other traditional analytical units within network studies. A shipwreck ostensibly strikes right at the heart of our inquiry: people and goods in motion, the distribution stage of economic movement, the purposeful assembly into one journey of different items that often contain traces of earlier journeys and other network dynamics. Yet the geographical position of a wrecked vessel and cargo may hold disappointingly little meaning from a basic spatial perspective. After all, the amphora pile that most often marks such sites did not complete the journey; these jars were not meant to reside on the seabed. Just comparing like with like, a ship carrying Cypriot pottery that wrecks off the coast of Spain while nearing its destination will look instinctually quite different by virtue of its location than it will if it sinks off the coast of Cyprus on the first day of its journey. Such examples should give us pause, and this is only the most straightforward of scenarios. In the case of complex cargos, how might we distinguish effectively between those picked up through cabotage and those assembled at one or more large warehouse ports? In the latter case, how should we model the multiple interlocked networks so tantalizingly implicit in this copresence of materials within a single ship’s hold? How can we synthesize the cargo, the galley wares or

personal possessions of a crew, and the material remains of the vessel itself—let alone such accidental travelers as the stowaway mouse from the Late Bronze Age Uluburun shipwreck (Cucchi 2008)—into a holistic network story that speaks at once to the individual journey as well as to the broader mechanisms and socioeconomic world behind such an assemblage?

Distilling networks from bulk artifact distributions raises a glaring fifth issue concerning how to integrate the spatial patterns—or, more properly, the quantified records of consumption at different sites—for the selective objects we happen to be capable of tracing archaeologically. That is, we can offer network representations based on individual classes of artifacts or products (most often through the surviving containers for wine, oil, etc.), however broadly we define these classes. Brughmans and Poblome (2015; 2016) have endeavored to test network methods through the diachronic distribution of particularly widespread classes of Roman finewares of known origin across the Mediterranean. Leaving aside the obvious caveat that such patterns will be strongest for only the most diagnostic artifacts, certainly a network built from the distribution of another object (e.g., transport jars) of the very same region could appear quite different, reflecting a range of alternative mechanisms at play (Autret et al. 2014). Given the many interconnected relationships underpinning maritime interaction, we should aim to embrace not just many complicated overlapping network diagrams, but also a holistic reflection and integrated approximation of real complexity.

Our final aim is perhaps straightforward and implicit from the previous discussion, but it should by no means be left underemphasized: we hope to push forward the study of Mediterranean maritime interaction through explicit and accessible network approaches, which may be more or less mathematical, but are all “models” in a basic sense and hence intellectually helpful if inevitably reductive. The range of reactions to network analysis underscores this point quite nicely, as does the constantly expanding repertoire of ways that scholars have usefully appropriated the term “network” and network concepts. Understanding how researchers focusing on different periods and traditions—for example, prehistoric archaeologists and ancient historians—value and employ (or eschew) some of these network ideas can offer new insights into how such tools might be bent to the questions and research concerns of multiple increasingly interdependent fields.

To this end, the contribution by **Tim Evans** (Chapter 2) provides a succinct overview and comparative evaluation of formal network methods for modeling cultural interaction and exchange. These range from the traditional proximal point analysis to stochastic models (including his own collaborative creation, *ariadne*) that offer a more natural approximation of real-world social systems. The next chapter (Chapter 3), by **Ray Rivers**, takes up these formal approaches to test the diachronic behavior of networks surrounding the

important eruption of Thera and the transition between the Middle and Late Bronze Age. He shows how the *ariadne* model effectively captures the functioning of the maritime interaction network before and after the removal of an evidently crucial node at Akrotiri on Thera. Working from a qualitative rather than quantitative approach, **Thomas F. Tartaron** (Chapter 4) pulls the discussion back into the practical lives of mariners in this Bronze Age Aegean setting, offering thoughtful critique of SNA and other formal network models commonly applied to date in studies of this early period. Augmenting the multi-scalar model from his previous work (Tartaron 2013) with ethnoarchaeological observation, he emphasizes the generally overlooked role of “local” as crucial to the formation and maintenance of connectivity and short-distance links that formed a powerful and persistent core of much seaborne activity.

Barbara Kowalzig (Chapter 5) offers a richly textured case study of the overlapping and mutually reinforcing economic and religious networks that extended across the Greek world. Organizing many facets of life amid Horden and Purcell’s (2000) Mediterranean maritime environment of opportunity and unpredictability was a regional “cultic cabotage” that, she finds, follows many of the behavioral properties of social networks. These strong links structured both economic integration and shared religious practice, and served as the foundation for preferential attachment of longer-distance “weak links” that could create “small-world” phenomena. The maritime material record of this same multi-scalar interaction forms the basis of **Elizabeth S. Greene**’s contribution (Chapter 6), which attempts to situate shipwreck assemblages conceptually and formally within broad network thinking. She adopts SNA visualization to posit a framework for Archaic Mediterranean maritime interaction based on cargo composition, while also exploring formally the internal connections within a full assemblage—not only cargo, but shipboard materials and even the ship itself—that attest to the individuals and broader cultural circuits in which objects and ideas were traveling. The amphoras that serve as our most robust testimony to Greek maritime commercial networks are the core data informing the simulation by **Mark L. Lawall and Shawn Graham** (Chapter 7), which explores how different network structures might create varied patterns in the introduction and adoption or failure of shapes of transport jars. The spatial results of their iterated economic simulations can be productively compared with the archaeological record, although contrasting network configurations can create indistinguishably similar patterns; a prime example of equifinality at work, this analytical reality suggests that while similar structures may be hypothesized for historical situations, proof of one particular structure or another is often elusive.

The appropriate systematic use of network models in making archaeological hypotheses forms the theme to **Tom Brughmans**’ contribution (Chapter 8) exploring, through statistical approaches and visualization, similarities and

differences in the distribution of eastern Roman tablewares. He emphasizes the crucial role of specific dependence assumptions in creating models that can be formally tested alongside other analytical methods and deployed when evaluating potential mechanisms behind artifact distribution patterns. Ceramic distributions form a core dataset also for **Paul Arthur, Marco Leo Imperiale, and Giuseppe Muci** (Chapter 9), who construct a Byzantine network based on shared material culture spanning the 8th-century Mediterranean and beyond. The particular properties of this connective structure are used to understand the maritime context—evidently a shrinking economy and perhaps top-down administrative directives—that allowed the multipurpose and now standardized globular amphora form to purge, at least temporarily, the range of competing jars. In her commentary on the preceding chapters, **Barbara J. Mills** (Chapter 10) weaves together themes common among the contributions, addressing some of the guiding questions behind the volume as well as underdeveloped but productive paths for future work. Drawing on contemporary archaeological perspectives, including from her own network-based studies in the American Southwest, she situates maritime connectivity and mobility within the scholarly dialog on network theory and analysis of cultural interaction.

For coast-hugging ancient populations, much of whose communication and travel was necessarily seaborne, the measurement of maritime networks takes on paramount importance for understanding cultural interaction, but at the same time these networks demand new and focused interdisciplinary approaches to the sorts of complex datasets that characterize connectivity and mobility. This volume brings together scholars of Mediterranean archaeology, ancient history, and complexity science to integrate theoretical approaches and analytical tools into models of maritime interaction within its social and spatial context. By bringing both theoretical approaches and analytical methods from network science to patterns of maritime communication, resource procurement, and exchange, we seek to understand the evolving structure and nature of socioeconomic connectivity that guided Mediterranean interaction manifested in the material and historical records. The contributions gathered here build connections not only among subfields of ancient studies spanning four millennia of human activity, but also across the traditional boundaries of humanities, social sciences, and physical sciences.

In gathering such studies together for this volume, we hope to make the most of what the study of the Mediterranean can offer: unrivaled case studies for long-term perspectives on maritime network structures across varied geography, institutions, and millennia. Networks provide a flexible analytical framework geared specifically toward addressing large and complex spatial and relational information, and as such hold considerable potential not only as general conceptual tools but also as formal methods for modeling

archaeological and historical data across the Mediterranean. Yet systematic applications of network methodologies to explore the overarching themes of maritime connectivity remain surprisingly few, in part no doubt because the challenges of such an approach outlined above are acute: balancing complexity and reduction, working across scales, and requiring research to bridge multiple disciplines and particular evidence sets, principally archaeology, Classics, and history. Despite such cautions, network perspectives provide a promising way forward. This general outlook has recently attracted attention in studies of ancient exchange and cultural interaction in diverse contexts that span the globe, offering the advantage of including here an additional perspective from outside the period and region. The recent emergence of a community of archaeologists and historians engaging with explicit network approaches to the ancient world provides occasion to build on earlier studies of Mediterranean maritime connectivity, and to integrate new formal concepts and tools from the social and physical sciences within this general framework of comparative historical inquiry.

NOTES

1. There are other arenas with interesting work that might form a focus of such a study, like the Caribbean, the Indian Ocean, or the Baltic. We have tried to leaven our Mediterranean maritime bias through inclusion of commentary from a specialist working in the completely landlocked environment of the American Southwest.
2. E.g., Knappett 2013; Mills et al. 2013; see also the Connected Past initiative at <http://connectedpast.soton.ac.uk>, with a follow-up publication (Brughmans, Collar, and Coward 2016), as well as a guest-edited volume of the *Journal of Archaeological Method and Theory* (Collar et al. 2015).
3. For shipwrecks, see the important catalogs provided and expanded in Parker 1992; 2008; Strauss 2013; <http://oxrep.classics.ox.ac.uk/databases/>; <http://darmc.harvard.edu/icb/icb.do>. For growing comparative studies of ports, see www.ancientportsantiques.com; <http://awmc.unc.edu>; www.portusproject.org; portuslimen.edu.

REFERENCES

- Abulafia, D. 2011. *The Great Sea: A Human History of the Mediterranean*. Oxford: Oxford University Press.
- Andreau, J., and Viriouvét, C. 2002. *L'information et la mer dans le monde antique*. Rome: École Française de Rome.
- Arnaud P. 2005. *Les routes de la navigation antique: Itinéraires en Méditerranée*. Paris: Editions Errance.
- Arnaud, P. 2014. Ancient mariners between experience and common sense geography. In K. Geus and M. Thiering (eds), *Features of Common Sense Geography: Implicit Knowledge Structures in Ancient Geographical Texts*, 39–68. Zurich: LIT Verlag.
- Autret, C., Dillon, M., Rauh, N.K., and Zoroğlu, L. 2014. The trading networks of ancient rough Cilicia. In S. Ladstätter, F. Pison and T. Schmidts (eds), *Häfen und Hafenzentren im östlichen Mittelmeerraum von der Antike bis in byzantinische Zeit: Neue Entdeckungen und*

- aktuelle Forschungsansätze (*Harbors and Harbor Cities in the Eastern Mediterranean from Antiquity to the Byzantine Period: Recent Discoveries and Current Approaches*), 593–618. Byzas 19. Istanbul: Ege Yayınları.
- Basch, L. 1987. *Le musée imaginaire de la marine antique*. Athens: Hellenic Institute for the Preservation of Nautical Tradition.
- Braudel, F. 1949. *La Méditerranée et le monde méditerranéen à l'époque de Philippe II*. Paris: Colin.
- Broodbank, C. 2000. *An Island Archaeology of the Early Cyclades*. Cambridge: Cambridge University Press.
- Broodbank, C. 2013. *The Making of the Middle Sea: A History of the Mediterranean from the Beginning to the Emergence of the Classical World*. London: Thames and Hudson.
- Brughmans, T. 2013. Thinking through networks: a review of formal network methods in archaeology. *Journal of Archaeological Method and Theory* 20, 623–662.
- Brughmans, T., Collar, A., and Coward, F. (eds) 2016. *The Connected Past: Challenges to Network Studies in Archaeology and History*. Oxford: Oxford University Press.
- Brughmans, T., and Poblome, J. 2015. Pots in space: an exploratory and geographical network analysis of Roman pottery distribution. In E. Barker, S. Bouzarovski, C. Pelling, and L. Isaksen (eds), *New Worlds from Old Texts: Revisiting Ancient Space and Place*, 255–80. Oxford: Oxford University Press.
- Brughmans, T., and Poblome, J. 2016. Roman bazaar or market economy? Explaining tableware distributions through computational modelling. *Antiquity* 90, 393–408.
- Brun, P. 1996. *Les archipels égéens dans l'antiquité grecque*. Besançon: Les Belles Lettres.
- Butzer, K.W. 2011. Geoarchaeology, climate change, sustainability: a Mediterranean perspective. *Geological Society of America Special Papers* 476, 1–14.
- Cadogan, G., Iacovou, M., Kopaka, K., and Whitley, J. (eds) 2012. *Parallel Lives: Ancient Island Societies in Crete and Cyprus. Proceedings of the Conference Held at Nicosia 1–3 December 2006*. London: British School at Athens.
- Casson, L. 1995. *Ships and Seamanship in the Ancient World*. 2nd edn. Baltimore: Johns Hopkins University Press.
- Clifford, J. 1997. *Routes: Travel and Translation in the Late Twentieth Century*. Cambridge, MA: Harvard University Press.
- Collar, A., Coward, F., Brughmans, T., and Mills, B., 2015. Networks in archaeology: phenomena, abstraction, representation. *Journal of Archaeological Method and Theory* 22, 1–32.
- Constantakopoulou, C. 2007. *The Dance of the Islands: Insularity, Networks, the Athenian Empire, and the Aegean World*. Oxford: Oxford University Press.
- Cresswell, T. 2011. Mobilities I: catching up. *Progress in Human Geography* 35(4), 550–558.
- Cucchi, T. 2008. Uluburun shipwreck stowaway house mouse: molar shape analysis and indirect clues about the vessel's last journey. *Journal of Archaeological Science* 35, 2953–2959.
- Davis, J.L. 1982. Thoughts on prehistoric and Archaic Delos. *Temple University Aegean Symposium* 7, 23–33.
- De Ligt, L., and Tacoma, L.E. 2016. Approaching migration in the early Roman Empire. In L. de Ligt and L.E. Tacoma (eds), *Migration and Mobility in the Early Roman Empire*, 1–22. Leiden: Brill.
- Evans, T., Knappett, C., and Rivers, R. 2009. Using statistical physics to understand relational space: a case study from Mediterranean prehistory. In D. Lane, D. Pumain, S. van der Leeuw and G. West (eds), *Complexity Perspectives on Innovation and Social Change*, 451–480. Berlin: Springer.
- Finley, M.I. 1973. *The Ancient Economy*. Berkeley: University of California Press.

- Ford, B. (ed.) 2011. *The Archaeology of Maritime Landscapes*. New York: Springer.
- Graham, S. 2006. Networks, agent-based models and the Antonine itineraries: implications for Roman archaeology. *Journal of Mediterranean Archaeology* 19(1), 45–64.
- Grove, A.T., and Rackham, O. 2001. *The Nature of Mediterranean Europe: An Ecological History*. London and New Haven: Yale University Press.
- Hage, P., and Harary, F. 1991. *Exchange in Oceania: A Graph Theoretic Analysis*. Oxford: Clarendon Press.
- Hage, P., and Harary, F. 1996. *Island Networks: Communication, Kinship and Classification Structures in Oceania*. Cambridge: Cambridge University Press.
- Harris, W.V. 2005. The Mediterranean and ancient history. In W.V. Harris (ed.), *Rethinking the Mediterranean*, 1–42. Oxford: Oxford University Press.
- Horden, P., and Purcell, N. 2000. *The Corrupting Sea: A Study of Mediterranean History*. Oxford and Malden: Blackwell.
- Ilves, K. 2009. Discovering harbours? Reflection on the state and development of landing site studies in the Baltic Sea region. *Journal of Maritime Archaeology* 4, 149–63.
- Ilves, K. 2011. Is there an archaeological potential for a sociology of landing sites? *Journal of Archaeology and Ancient History* 2, 1–31.
- Isaksen, L. 2008. The application of network analysis to ancient transport geography: a case study of Roman Baetica. *Digital Medievalist* 4, at <https://journal.digitalmedievalist.org/articles/10.16995/dm.20>.
- Khatchadourian, L. 2016. *Imperial Matter: Ancient Persia and the Archaeology of Empires*. Oakland: University of California Press.
- Knapp, A.B., and van Dommelen, P. 2010. Material connections: mobility, materiality and Mediterranean identities. In P. van Dommelen and A.B. Knapp (eds), *Material Connections in the Ancient Mediterranean: Mobility, Materiality and Identity*, 1–18. London: Routledge.
- Knappett, C. 2011. *An Archaeology of Interaction: Network Perspectives on Material Culture and Society*. Oxford: Oxford University Press.
- Knappett, C. (ed.) 2013. *Network Analysis in Archaeology: New Approaches to Regional Interaction*. Oxford: Oxford University Press.
- Knappett, C. 2016. Networks in archaeology: between scientific method and humanistic metaphor. In T. Brughmans, A. Collar, and F. Coward (eds), *The Connected Past: Challenges to Network Studies in Archaeology and History*, 21–33. Oxford: Oxford University Press.
- Knappett, C., Evans, T., and Rivers, R. 2008. Modelling maritime interaction in the Aegean Bronze Age, *Antiquity* 82, 1009–1024.
- Knappett, C., Evans, T., and Rivers, R. 2011. The Theran eruption and Minoan palatial collapse: new interpretations gained from modelling the maritime network. *Antiquity* 85, 1008–1023.
- Knappett, C., and Kiriati, E. 2016. Introduction. In E. Kiriati and C. Knappett (eds), *Human Mobility and Technological Transfer in the Prehistoric Mediterranean*, 1–17. British School at Athens Studies in Greek Antiquity 1. Cambridge: Cambridge University Press.
- Larson, K.A. 2013. A network approach to Hellenistic sculptural production. *Journal of Mediterranean Archaeology* 26(2), 235–260.
- Laurence, R. 1999. *The Roads of Roman Italy: Mobility and Cultural Change*. London: Routledge.

- Leidwanger, J. 2013. Modeling distance with time in ancient Mediterranean seafaring: a GIS application for the interpretation of maritime connectivity. *Journal of Archaeological Science* 40, 3302–3308.
- Leidwanger, J. 2017. From time capsules to networks: new light on Roman shipwrecks in the maritime economy. *American Journal of Archaeology* 121(4), 595–619.
- Leidwanger, J. 2018. The power of coastal resources: assessing maritime economic opportunity in the Roman Mediterranean. In E. Holt (ed.), *Water and Power in Past Societies*, 217–240. Albany: State University of New York Press.
- Leidwanger, J., Knappett, C., Arnaud, P. Arthur, P., Blake, E., Broodbank, C., Brughmans, T., Evans, T., Graham, S., Greene, E.S., Kowalzig, B., Mills, B., Rivers, R., Tartaron, T., and van de Noort, R. 2014. A manifesto for the study of Mediterranean maritime networks. *Antiquity* 342. <http://journal.antiquity.ac.uk/projgall/leidwanger342>.
- Leonard, J.R. 2005. *Roman Cyprus: harbors, hinterlands, and hidden powers*. Unpublished PhD dissertation, State University of New York at Buffalo.
- Leveau, P., Trément, F., Walsh, K., and G. Barker (eds) 1999. *Environmental Reconstruction in Mediterranean Landscape Archaeology*. Oxford: Oxbow Books.
- Lytle, E. 2012. Ἡ θάλασσα κοινή: fishermen, the sea, and the limits of ancient Greek regulatory reach. *Classical Antiquity* 31(1), 1–55.
- McCormick, M., Huang, G., Gibson, K. et al. 2013. Summary geodatabase of shipwrecks AD 1–1500, status 2008. The Digital Atlas of Roman and Medieval Civilizations (DARMC) Scholarly Data Series, Data Contribution Series #2013-1. Cambridge: Center for Geographic Analysis, Harvard University. <https://darmc.harvard.edu>.
- Malkin, I. 2011. *A Small Greek World: Networks in the Ancient Mediterranean*. Oxford: Oxford University Press.
- Marriner, N., and Morhange, C. 2007. Geoscience of ancient Mediterranean harbours. *Earth-Science Reviews* 80, 137–94.
- Mills, B.J., Clark, J.J., Peeples, M.A., Haas, W.R., Jr., Roberts, J.M., Jr., Hill, J.B., Huntley, D.L., Borck, L., Breiger, R.L., Clauset, A., and Shackley, M.S. 2013. Transformation of social networks in the late pre-Hispanic Southwest. *Proceedings of the National Academy of Sciences* 110(15), 5785–5790.
- Moatti, C. (ed.) 2004. *La mobilité des personnes en Méditerranée, de l'antiquité à l'époque moderne: Procédures de contrôle et documents d'identification*. Rome: Ecole française de Rome.
- Moatti, C. 2006. Translation, migration, and communication in the Roman Empire: three aspects of movement in history. *Classical Antiquity* 25(1), 109–40.
- Morton, J. 2001. *The Role of the Physical Environment in Ancient Greek Seafaring*. Leiden: Brill.
- Newman, M.E.J., Barabási, A.-L., and Watts, D.J. (eds) 2006. *The Structure and Dynamics of Networks*. Princeton: Princeton University Press.
- Oka, R., and Kusimba, C.H. 2008. The archaeology of trading systems, Part 1: towards a new trade synthesis. *Journal of Archaeological Research* 16, 339–395.
- Oleson, J.P., and Hohlfelder, R.L. 2011. Ancient harbors in the Mediterranean. In A. Catsambis, B. Ford, and D.L. Hamilton (eds), *The Oxford Handbook of Maritime Archaeology*, 809–833. Oxford: Oxford University Press.
- Osborne, R. 2011. *The History Written on the Classical Greek Body*. Cambridge: Cambridge University Press.
- Parker, A.J. 1992. *Ancient Shipwrecks of the Mediterranean and the Roman Provinces*. BAR International Series 580. Oxford: Tempus Reparatum.

- Parker, A.J. 2008. Artifact distributions and wreck locations: the archaeology of Roman commerce. In R.L. Hohlfelder (ed.), *The Maritime World of Ancient Rome, 177–196*. Ann Arbor: University of Michigan Press.
- Pomey, P. (ed.) 1997. *La navigation dans l'antiquité*. Aix-en-Provence: Edisud.
- Preiser-Kapeller, J. 2015. Harbours and maritime mobility: networks and entanglements. In J. Preiser-Kapeller and F. Daim (eds), *Harbors and Maritime Networks as Complex Adaptive Systems*, 119–139. RGZM Monograph 23. Mainz: Römisch-Germanischen Zentralmuseum, 2015.
- Rackham, O., and Moody, J. 1996. *The Making of the Cretan Landscape*. Manchester: Manchester University Press.
- Renfrew, C. 1975. Trade as action at a distance: questions of integration and communication. In J.A. Sabloff and C.C. Lamberg-Karlovsky (eds), *Ancient Civilization and Trade*, 3–59. Albuquerque: University of New Mexico Press.
- Renfrew, C. 1980. The great tradition versus the great divide: archaeology as anthropology? *American Journal of Archaeology* 84(3), 287–298.
- Rice, C. 2016. Shipwreck cargoes in the Western Mediterranean and the organization of Roman maritime trade. *Journal of Roman Archaeology* 29, 165–192.
- Rivers, R., Knappett, C., and Evans, T. 2013. Network models and archaeological spaces. In A. Bevan and M. Lake (eds), *Computational Approaches to Archaeological Spaces*, 99–126. London: UCL Press.
- Rivers, R., Evans, T., and Knappett, C. 2016. From oar to sail. In C. Ducruet (ed.), *Maritime Networks: Spatial Structures and Time Dynamics*, 63–76. Routledge Studies in Transport Analysis. London: Routledge.
- Rougé, J. 1966. *Recherches sur l'organisation du commerce maritime en Méditerranée sous l'Empire romain*. Paris: S.E.V.P.E.N.
- Sabloff, J., and Lamberg-Karlovsky, C.C. (eds) 1975. *Ancient Civilization and Trade*. Albuquerque: University of New Mexico Press.
- Sherratt, A., and Sherratt, S. 1993. The growth of the Mediterranean economy in the early first millennium BC. *World Archaeology* 24, 361–78.
- Smith, A.T. 2003. *The Political Landscape: Constellations of Authority in Early Complex Polities*. Berkeley: University of California Press.
- Strasser, T.F. 2010. Location and perspective in the Thera Flotilla Fresco. *Journal of Mediterranean Archaeology* 23(1), 3–26.
- Strauss, J. 2013. *Shipwrecks Database*, Version 1.0. Oxford Roman Economy Project. oxrep.classics.ox.ac.uk/databases/shipwrecks_database.
- Tartaron, T.F. 2013. *Maritime Networks in the Mycenaean World*. Cambridge: Cambridge University Press.
- Terrell, J. 1977. *Human Biogeography in the Solomon Islands*. Chicago: Field Museum of Natural History.
- van der Leeuw, S.E. 1998. *The Archaeomedes Project: Understanding the Natural and Anthropogenic Causes of Land Degradation and Desertification in the Mediterranean Basin*. Luxembourg: Office for Official Publications of the European Communities.
- Vita-Finzi, C. 1969. *The Mediterranean Valleys: Geological Changes in Historical Times*. Cambridge: Cambridge University Press.
- Wachsmann, S. 1998. *Seagoing Ships and Seamanship in the Bronze Age Levant*. College Station: Texas A & M University Press.
- Watts, D. J. and Strogatz, S.H. 1998. Collective dynamics of “small-world” networks. *Nature* 393, 440–442.

- Westerdahl C. 1992. The maritime cultural landscape. *International Journal of Nautical Archaeology* 21(1), 5–14.
- Westerdahl, C. 2010. “Horses are strong at sea”: the liminal aspect of the maritime cultural landscape. In A. Anderson, J.H. Barrett, and K.V. Boyle (eds), *The Global Origins and Development of Seafaring*, 275–287. Cambridge: McDonald Institute for Archaeological Research.
- Westerdahl C. 2011. The maritime cultural landscape. In A. Catsambis, B. Ford, and D.L. Hamilton (eds), *The Oxford Handbook of Maritime Archaeology*, 733–762. Oxford: Oxford University Press.
- Whitelaw, T. 2017. The development and character of urban communities in prehistoric Crete in their regional context. In Q. Letesson and C. Knappett (eds), *Minoan Architecture and Urbanism: New Perspectives on an Ancient Built Environment*, 114–180. Oxford: Oxford University Press.
- Woolf, G. 2016. Movers and stayers. In L. de Ligt and L.E. Tacoma (eds), *Migration and Mobility in the Early Roman Empire*, 438–461. Leiden: Brill.