Journal of Archaeological Research
https://doi.org/10.1007/s10814-023-09189-9

Shell Midden Archaeology: Current Trends and Future Directions

Torben C. Rick[1]

Accepted: 16 July 2023

Abstract

Since the 19th century, the study of shell middens has played an important role in archaeological research. Shell midden and broader coastal archaeology have transformed our understanding of human relationships with aquatic habitats, demonstrating the importance of marine environments to human evolution and ecology, the colonization of islands and establishment of maritime trade networks, changing social and political dynamics, and a variety of other issues. During the past two decades, shell midden research has greatly increased, marking an exciting time for new discoveries and heightened collaboration with Indigenous communities. Several key research trends in shell midden archaeology during the past 10–15 years include research on site distribution and temporality, underwater archaeology, historical ecology, terraforming, landscape legacies, and community collaboration. These research trends demonstrate the ways in which shell midden archaeologists are shaping our understanding of the human past and environmental change around the world.

Keywords Maritime adaptations · Coastal archaeology · Historical ecology · Environmental archaeology

Introduction

From commerce to geopolitics, climate, food, and leisure, the ocean and other aquatic habitats play a central role in people's lives. While archaeologists have at times vigorously debated the importance of marine and other aquatic environments in human evolution, culture, and ecology, most researchers today agree that coastal environments also had an important role in the human past, evidenced in Indigenous

✉ Torben C. Rick
rickt@si.edu

[1] Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20013-7012, USA

oral histories and living memories, written accounts, and the archaeological record (Bailey and Milner 2002; Erlandson 2001; Erlandson and Fitzpatrick 2006; Gillis 2012; Jerardino 2016; Marean 2014, 2016; Waselkov 1987). A foundational component of this research is the archaeological investigation of shell middens—archaeological sites that contain shell, artifacts, bone, plant remains, and other materials (Fig. 1; Campbell 2005; Waselkov 1987).

For roughly 200 years, archaeologists and other researchers have investigated shell middens. Although shell middens were described earlier, foundational shell midden research can be traced to Denmark in the 1800s, after which it quickly expanded in the late 19th and early 20th centuries as archaeologists built strategies for evaluating site stratigraphy and formation and debated the natural versus cultural origins of site constituents (Anderson 2000; Claassen 1999; Milner et al. 2007a; Robson et al. 2023; Trigger 1986; Waselkov 1987). Archaeological research on shell middens and coastal archaeology accelerated in the late 1980s and 1990s, building on new techniques for investigating the archaeological record (Claassen 1991; Stein 1992; Waselkov 1987). This led to an explosion of shell midden research during the 21st century, including publication of several shell midden/coastal archaeology volumes and journal special issues (e.g., Allen 2017; Bailey et al. 2013; Bailey and Hardy 2021a; Balbo et al. 2011; Betts and Hrynick 2017; Bjerk et al. 2016; Gutiérrez-Zugasti et al. 2016; Milner et al. 2007b; Roksandic et al. 2014; Szabó et al. 2014).

Part of what makes shell midden research important and diverse is the assorted and rich constituents that these sites contain, the durable nature of shells, and their conspicuous visibility on the landscape (Bailey and Parkington 1988). These factors have allowed shell midden archaeologists to investigate a wide range of topics of global archaeological and interdisciplinary significance. Shell midden archaeologists have been particularly adept at addressing five key issues: (1) the importance of

Fig. 1 Late Holocene shell midden on San Miguel Island, California. Inset: common constituents identified in shell middens. Shellfish: A. California mussel shell, B. black abalone shell, C. gastropod operculum; animal bones and sediments: D. fish bone, E. seal humerus; F. soils and sediments; artifacts and botanicals: G. shell fishhook, H. chipped stone tool; I. archaeobotanicals/charcoal

coastal resources in human history and cultural evolution, (2) the impact of past peoples on terrestrial and aquatic organisms and ecosystems, (3) the ways people altered their land and seascapes through daily activities, village construction, ceremony, and ritual, (4) archaeological site formation processes, and (5) how to increase collaboration with descendant communities, foster inclusion, and promote multiple ways of knowing the past (Bailey and Hardy 2021a; Erlandson and Fitzpatrick 2006; Fitzpatrick et al. 2016; Lightfoot et al. 2021).

In this paper, I review shell midden archaeology during the past 10–15 years, focusing on the five global issues noted above and drawing on archaeological research around the world (Fig. 2). This review is organized into seven sections:

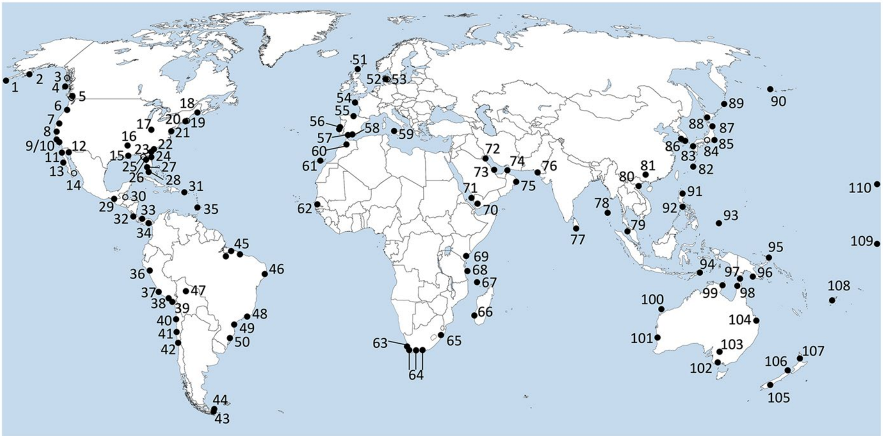

Fig. 2 Approximate locations for localities, key sites, complexes, or regions discussed in the text. Open circles denote key underwater/intertidal sites. 1. Aleutian Islands (eastern), 2. Kodiak/Chirikof, 3. Port Houghton/southeast Alaska, 4. Kilgii Gwaay/Haida Gwaii, 5. Quadra Island, BC, 6. Seaside, Oregon, 7. Northern California, 8. San Francisco Bay, 9. Central California, 10. California Channel Islands, 11. Escorpiones site, 12. San Felipe region/Totoaba, 13. Isla Cedros, 14. Espirtu Santo, 15. Coquile, 16. Yazoo River, 17. Green River, 18 Maine, 19. Ninigret Pond, 20. Connecticut/Pequot, 21. Chesapeake Bay, 22. Sea Pines, SC, 23. Georgia Coast Mounds, 24. St. Johns River, 25. Econfina, 26. Shell Mound/Crystal River, 27. Mound Key, 28. Florida Keys, 29. Chantuto, 30. Maya submerged site, 31. Puerto Rico, 32. Costa Rica, 33. Sitio Drago, 34. Pearl Islands, 35. Cariacou, 36. Huaca Prieta, 37. La Yerba 2, 38 Quebrada Jaguay, 39. Ring site, 40. Zapatero, 41. El Teniete Bay, 42 Punta Ñagué, 43. Beagle Channel, 44. Isla Grande, 45. Minas sites, 46. Saco de Pedra, 47. Lannos de Moxos, 48. Saquarema region sambaquis, 49. Babitanga Bay sambaquis, 50. Santa Marta/Camacho sambaquis, 51. Orkney, 52. Denmark, 53. Hjarnø, 54. Brittany, 55. Cantabria, 56. Figuria Brava and Muge, 57. Gibraltar, 58. Bajondillo Cave, 59. Grotta d' Orienta, 60. Early Moroccan middens, 61. Canary Islands, 62. Saloum Delta, 63. Elands Bay (megamiddens), 64. Yserfontein/Pinnacle Point/Klasies River Mouth, 65. Eastern South Africa. 66. Velondriake, 67. Comoros Islands, 68. Mafia Archipelago, 69. Panga ya Saidi, 70. Jizan/Hodeidah, 71. Farasan Islands, 72. H3, Kuwait, 73. Khor, Qatar, 74. ar-Ramlah, 75. Oman, 76. Daun-1, Pakistan, 77. South Sri Lanka, 78. Andaman Islands, 79. Guar Kepah, 80. Vietnam caves, 81. Guangxi, 82. Ryuku Islands, 83. Higashimyo, 84. Awazu, 85. Nakazato, 86. South Korea sites, 87. Sakiyama, 88. Kitogane, 89. Kuril Islands, 90. Western Aleutians Islands, 91. Cagayan Valley, 92. Bubog 1 Rockshelter, 93. Palau, 94. Lene Hara, East Timor, 95. Matenbeck Cave, New Ireland, 96. Caution Bay, 97. Torres Strait, 98. Albatross Bay, 99. Blue Mud Bay, 100. Barrow Island, 101. Southwest Australia middens, 102. Moyjil, 103. Willandra Lakes/Murray/Darling, 104. Curtis coast middens, 105. Shag River, 106. Tata beach, 107. Aukland Isthmus, 108. Fiji, 109. Kiribati, 110. Hawaii

(1) distribution and temporality, (2) submerged shell middens and paleolandscapes, (3) historical ecology and human–environment interactions, (4) terraforming, shell mounds, and megamiddens, (5) landscape legacies, (6) climate change, coastal erosion, and the curation crisis, and (7) community collaboration. Although shell middens are often discrete, independent sites, shell middens also occur at larger village sites, or in mixed middens of bone and other constituents. Consequently, some of the research topics discussed here pertain to those diverse site types and constituents and are not solely based on shell midden components. I begin with a discussion of core concepts and definitions of shell middens and conclude with future research directions.

Core Concepts and Fundamentals

While interest in shell middens dates back to the early 1800s (and earlier), formal research on shell middens grew during the mid to late 1800s, including in Denmark, other parts of Europe, and North America where early scholars debated the origins of shell middens and helped build a foundation for stratigraphic excavation and the construction of relative chronologies (Álvarez et al. 2011; Anderson 2000; Christensen 1986; Claassen 1999; Dall 1877; Milner et al. 2007a; Morlot 1861; Randall 2015a; Robson et al. 2023; Wyman 1868). Shell middens were soon being investigated around the world, including in Australia (Stratham 1892), Japan (Morse 1877), Southeast Asia (Rabett et al. 2011), South America (Zangrando 2018), Portugal (Cardoso 2015), the Chesapeake and San Francisco Bays (Holmes 1907; Uhle 1907), and beyond. Shell midden archaeology has been interdisciplinary since people first started to research the site type, including work by archaeologists, geologists, naturalists, and others (Trigger 1986).

From the 1940s–1970s, research on shell middens grew as archaeologists from Europe, Australia, Africa, the Americas, and Asia expanded on earlier excavations and focused on questions around diet, quantification of midden constituents, and sampling/excavation strategies (Ambrose 1967; Bailey 1975; Greenwood 1961; Koloseike 1970; Meighan 1959; Parkington 1976; Parmalee and Klippel 1974; Terrell 1967; Treganza and Cook 1948). These trends continued, and during the 1980s–1990s, several studies painted an increasingly complex picture of shell midden research, laying the groundwork for the ensuing florescence of shell midden studies today (e.g., Attenbrow 1992; Claassen 1991; Kirch 1982; Lightfoot 1986; Waselkov 1987).

Many studies in the 1980s and 1990s continued to investigate site formation and taphonomy, including past and ongoing mining and destruction of shell middens (Ceci 1984). Stein's (1992) research at the British Camp Shell Midden on the San Juan Islands, Washington, pushed research on shell midden formation processes forward, made taphonomic studies essential for future work, and was a driver of geoarchaeological research on shell middens through today. Similarly, Claassen's (1991) emphasis on sampling procedures and subsampling of fauna and artifacts, ethnoarchaeology, and experimental research enhanced perspectives on food and feeding, nutrition (kilocalories, etc.), and habitat reconstruction.

Meehan's (1982) classic ethnography of Australia provided an explanatory framework for interpreting the archaeological record, as did more recent studies in the Torres Strait, which focused on shellfish collecting by children (Bird and Bliege Bird 2000). Others weaved ethnohistory and archaeology together to demonstrate the value of shellfish to Tlingit along the Pacific Northwest Coast, providing additional perspectives for how to better interpret shell middens (Moss 1990). Ethnographic accounts, ethnoarchaeology, and analysis of modern middens figure prominently in other more recent studies, providing additional information for interpreting the function and context of shell middens (Hardy et al. 2016; Mannino and Thomas 2002; Voorhies and Martínez-Tagüeña 2018; Woodman 2013).

While many studies focus on marine/estuarine coastal sites, shell middens also occur in riverine and lacustrine regions and other inland areas that contain shellfish (Figuti and Plens 2014; Marquardt and Watson 2005; Taylor and Bell 2017). The Green River region of Kentucky and the broader Ohio River valley, for instance, played a seminal role in the history of shell midden archaeology from Moore (1916) to Marquardt and Watson (1983, 2005), Claassen (1993, 2013), Milner and Jefferies (1998), Sassaman (1995), Jefferies (2008), and Moore and Thompson (2012). Each successive study raised important issues from site formation to feasting, ceremonialism, and gender and status.

Like many aspects of archaeological and scientific research, archaeologists often debate the appropriate terminology used to define shell middens. This includes terms like shell-bearing site, shell mound, shell ring, shell heap, shell-matrix site, and more, with these terms often used interchangeably by researchers (Claassen 1991; Marquardt 2010). The term 'shell midden' comes from the Danish word *køkkenmøddinger* and is defined as "a special type of coastal settlement in which shell refuse is a dominant part but which is mixed with cultural debris such as flint, bone, antler, charcoal, ceramics, ash, fire-cracked stones ('potboilers'), and features such as hearths, pits, stake-holes, and graves, etc." (Anderson 2000, p. 362). In Denmark, at least 50% of the volume of the deposit must be shell and shell fragments and exceed a continuous horizon of at least 10 m^2. This is a rare example of specific quantified metrics being used to define a shell midden (Anderson 2000; Robson et al. 2023).

Drawing on an unpublished paper by Widmer (1989), Claassen (1991, p. 252) presented Widmer's types of shell-bearing deposits: shell midden site, shell midden, shell-bearing midden site, and shell-bearing habitation site. This typology sought to explain the different functions of shell middens at, near, or away from residential sites, but it was never widely adopted by researchers. The exception is the term 'shell-bearing site,' which is often used today to simply indicate that a site contains shell. Stein (1992, p. 6) noted that the term 'shell midden' has connotations that are inaccurate (e.g., association with dwelling places) but still opted to use it over other terms (shell-bearing site) to describe sites that contain shell.

By the 2000s, archaeologists continued to investigate shell middens and define the site type. Wells (2001, p. 164) argued that "[s]hell middens are conspicuous anthropogenic deposits of shell, gravel, sand, silt, charcoal, artifacts, and other cultural and geological remains." Marquardt's (2010) discussion of the need for a sediment-oriented approach highlighted the various names given to shell middens in the American Southeast, including shell mounds, shell heaps, shell works, and shell rings, terms often used inconsistently. To this list, we can add the *concheros* or *conchales* terminology used in Argentina and Chile and *sambaquis* used in southern Brazil (Zangrando 2018). While my focus is on primary works in English and not other languages like Japanese, Portuguese, and Spanish, there are likely additional terms as well.

Other researchers emphasize the importance of the sedimentary matrix, with the term 'shell-matrix site' building on the earlier shell-bearing site (Roksandic et al. 2014). For example, Marean (2014) used shell middens as an indicator of the antiquity of coastal adaptations, relying on the matrix as a key variable. To Marean (2014, p. 21) "… the definition of shell midden rests on the sediment being shell supported, such that shells inter-finger with other shells and the matrix fills in between. This is a 'clast-supported' matrix and its recognition is based on the presence of clasts (shells) that dominate the sediment and matrix filling the voids."

Many scholars refer to shell middens as refuse or garbage, which relates back to køkkenmøddinger (e.g., Anderson 2000; Rick et al. 2016; Szabó 2017). Shell middens are much more than refuse, however, and are intertwined with people's identities, beliefs, ceremonies, and rituals (McNiven 2013; Randall 2015b; Reeder-Myers et al. 2022; Roksandic et al. 2014). McNiven (2013, p. 553) challenged archaeologists to see beyond middens as refuse: "But are all shell middens merely secular refuse dumps? Is it possible that in some cases middens are not simply the inadvertent by-product of the tethered discard of generations of food refuse but carefully and deliberately constructed features with active roles within the systemic social realm? If so, is it appropriate to refer to these middens as dumps, to refer to the addition of materials to these sites as refuse disposal and indeed to refer to their contents as rubbish?" In this sense, middens are often selective, ritualized deposits and "living architecture" (McNiven 2013).

Today most research on shell middens focuses on the diversity in size, function, contents, and other characteristics. For instance, Moss (2011, p. 123) argued that Northwest Coast shell middens are part of the built environment, challenging previous notions that shell middens were not intentionally created. While some shell middens may be refuse piles, shell middens are often purposefully created, including burials, landforms, prepared areas for houses, and more (Moss 2011; Parkington and Brand 2020; Roksandic et al. 2014).

This discussion illustrates the complex array of terms, descriptions, and definitions for shell middens, a view shared by Waselkov (1987, p. 95) who noted the many definitions of a shell midden and opted for a general definition: "a cultural deposit of which the principle visible constituent is shell." I agree and opt for this simplistic and all-encompassing definition, with the broadest terminology being the most parsimonious. However, in specific contexts, more precise (shell matrix) or more descriptive (shell mound or shell ring) terms may be more appropriate than the simplified and generalized term, shell midden. I encourage researchers to abandon referring to shell middens as refuse, rubbish, or trash—these terms lack sensitivity for descendant communities and clearly do not cover the multitude of site types and the often-sensitive context of shell middens. Because other terms may also carry unwittingly negative connotations to some groups of people, or are not the most germane for discussing sites with nonspecialists, I argue for refinement of the term 'shell midden' rather than abandonment.

Distribution and Temporality

A fundamental part of archaeological research on shell middens is evaluating their distribution, age, and relationship to human behavior and culture. Shell middens dated to the Holocene have a global distribution and are found on every continent except Antarctica (Robson et al. 2023; Waselkov 1987). Shell middens are generally absent or rare in polar regions where environmental conditions often drove people to focus on other resources. However, shell middens are found in high latitude areas of the North Pacific, including the Gulf of Alaska, Aleutian Islands, and in the southern hemisphere to Tierra del Fuego, Tasmania, and southern New Zealand. Shell middens also occur in temperate zones and the tropics. Shell middens are common in marine coastal environments around estuaries, rocky and sandy shores, and kelp forests. They also are abundant in some freshwater habitats around rivers and lakes. While I focus on the antiquity and time depth of shell middens, ethnographic accounts document the use of shellfish and formation of shell middens through historical and modern times (Meehan 1982; Voorhies and Martínez-Tagüeña 2018; Waselkov 1987)

Determining the time depth or antiquity of shell middens around the world is complicated by postglacial sea level rise that prohibits site discovery and is intertwined with how one defines a shell midden (Marean 2014). Many shell middens, particularly large, diverse midden mounds, appeared during the Holocene, and shell middens of all types proliferated around the world after 8000–6000 years ago (Bailey and Hardy 2021b; Bailey and Milner 2002; Erlandson 2001; Waselkov 1987). The seemingly recent (Holocene) appearance or dramatic increase of shell middens was once used to indicate that marine and other aquatic resources were a late component of human adaptations and played a marginal or peripheral role in human evolution (Erlandson 2001). However, marine and other aquatic foods have a deep history of use by anatomically modern humans and Neandertals, and some of these findings come from shell middens (Erlandson 2001; Jerardino 2016; Marean 2014; Rowland et al. 2021).

Previous studies have tracked the antiquity of human use of aquatic and marine foods and their relationship to shell middens. For instance, Waselkov (1987, pp. 123–124) reviewed the antiquity and distribution of shellfish exploitation, noting small quantities of shell at Terra Amata by 300,000 years ago, a number of sites also containing shellfish remains in southern Africa by 130,000–30,000 years ago, and sites in Gibraltar, Libya, and Australia by 47,000–20,000 years ago. Erlandson (2001: tables I and II) synthesized numerous shell midden and other localities with possible use of aquatic fauna extending back 1–2 million years and shell middens appearing after about 150,000 years ago. I build on these studies to highlight evidence for Pleistocene shellfish exploitation and its relationship to shell midden sites.

Several scholars have reviewed the antiquity of coastal resource use in recent years and its role in human evolution in southern Africa (e.g., Jerardino 2016; Klein and Bird 2016; Marean 2014; Will et al. 2016, 2019, 2022). Marean (2014, p. 21) used "the presence of shell middens as a core archaeological proxy indicator of a coastal adaptation," noting that there is a continuum from dense to low-density sites containing shells. The regular occurrence of shell is evidence of coastal resource use, while small numbers of shells could be attributed to other organisms (e.g., birds) (Erlandson 2001; Jerardino 2016; Marean 2014). The ~160,000-year-old component at Pinnacle Point contains early evidence of Middle Stone Age shellfishing in southern Africa, but denser shell-bearing deposits at Klasies River Mouth, Yserfontein 1, Klipdrift, and Blombos are somewhat later between roughly 120,000 and 70,000 years ago (Fig. 3) (see Brenner et al. 2022; Jerardino 2016; Klein and Bird 2016; Marean et al. 2007; Niespolo et al. 2021; Will et al. 2016, 2019; Wurz et al. 2022).

The eastern coast of South Africa has received less attention than the western coast, but there was sustained Middle and Late Stone Age coastal resource use there as well (Will et al. 2022). At the other end of the continent, sites containing shellfish in Morocco (northwestern Africa) include several examples of diverse deposits of shell dating from 130,000 years ago through the Holocene (Chakroun et al. 2017), but many potentially early sites in the region remain poorly dated (Marean 2014). The seasonal nature of shellfish collecting and the conspicuous presence and durability of shellfish sites suggest that some of the oldest accumulations are perhaps from only a few collecting episodes (Klein and Bird 2016).

Further evidence of early coastal resource use comes from Panga ya Saidi in Kenya, where coastal resource use extends back 67,000 years, the oldest such sequence in eastern Africa (Faulkner et al. 2021). Coastal engagement at Panga ya Saidi denotes a relationship with the coast but not necessarily a full range of coastal adaptations. While the site is not referred to as a shell midden, some 38 invertebrate taxonomic categories, including 23 marine gastropods, nine marine bivalves, and freshwater mollusks were identified. Panga ya Saidi documents fluctuating coastal

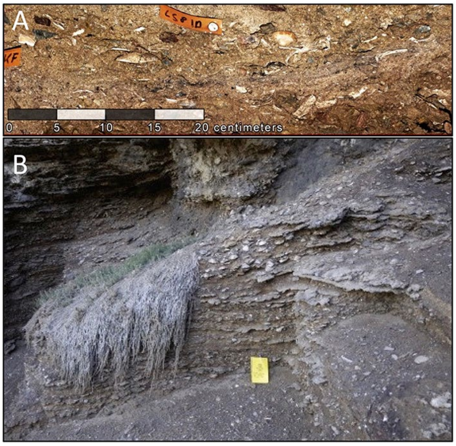

Fig. 3 Early South African shell middens: A. shell deposits at Pinnacle Point; B. dense limpet-dominated midden at Klasies River Mouth, Cave A (photos by Curtis Marean and adapted from Marean 2014)

engagement through time, but the presence of fairly regular aquatic shellfish use falls within the continuum of shell midden sites (Faulkner et al. 2021).

Marine mollusk use in the Mediterranean may extend back 300,000 years, but clear evidence comes from caves and denser deposits dated much later in time (Colonese et al. 2011). Two cave sites, Bajondillo Cave in Spain and Figueria Brava in Portugal, demonstrate that coastal resource use was a component of both anatomically modern human and Neandertal diet (Will 2020; Will et al. 2019; Zilhão et al. 2020). At Bajondillo Cave, sparse shellfish remains date to 150,000 years ago; they may not be a shell midden but document early shellfish collecting (Cortés-Sánchez et al. 2011; Marean 2014). However, early evidence of routine shellfish collecting, and fish, dolphin, and marine bird remains dates to 106,000–86,000 years ago at Figueria Brava (Zilhão et al. 2020), where shellfish and fish densities are within the range of the highest frequency Middle Stone Age sites in southern Africa (Will 2020). Gorhams and Vangaurd Caves in Gibraltar also contain shellfish and other marine foods dated to >28,000 years ago (Fa et al. 2016; Stringer et al. 2008). Collectively, synthesis for Iberia and adjacent regions indicates coastal resource use >100,000 years ago, but the data are scant until around 40,000–30,000 years ago and then explode with numerous shell middens in the Holocene (Bicho and Esteves 2022).

In Australia and Island Southeast Asia, sea level rise has obscured the record of early sites, but shellfish and fish harvest are evident by at least 44,000–42,000 years ago, with increasing interisland and sea voyaging trade by 25,000 years ago (Rowland et al. 2021). Shell midden deposits at Lene Hara Cave, East Timor, date to 35,000 years ago, with shellfish and fishes including offshore tunas being deposited in other sites on East Timor 42,000 years ago (O'Connor et al. 2002, 2011). Other caves in Indonesia also chronicle early marine food use around 40,000 years ago and then dense middens forming after 14,000 years ago (Kealy et al. 2020). Consistent and widespread evidence for shell middens and coastal adaptations in Australia does not appear until the terminal Pleistocene/Early Holocene, a pattern strongly influenced by sea level rise (Ditchfield et al. 2022). However, significant quantities of shellfish are present in the 42,000-year-old deposits at Bodie Cave on Barrow Island, with even greater abundance in the 18,000-year-old or later deposits at sites in the Barrow/Montebello Island area (Manne and Veth 2015; Veth et al. 2017). A few open-air interior freshwater shellfish middens in the Willandra Lakes/Darling River area are Late Pleistocene in age (~40,000 years) (O'Connell and Allen 2012). Collectively, these data support the presence of shellfish and fishes in archaeological sites dating to ~45,000–35,000 years ago in Australia and Island Southeast Asia, including relatively dense middens around 25,000 years ago and later (Codding et al. 2014; Rowland et al. 2021). One caveat is the potential shell midden at the Moyjil site, Southwest Victoria, that could date to 120,000 years ago, but there is considerable debate about whether these deposits are cultural or natural (Bowler et al. 2018; McNiven et al. 2018).

Beyond Africa, Europe, and Australasia, research on shell middens dating to the Pleistocene is more limited. In Vietnam, a microstratigraphic approach documented shell midden deposits that are roughly 22,000–18,000 years old, supporting early shellfish use at inland sites in tropical forests (McAdams et al. 2022). To the north, Sakitari Cave, Okinawa, produced evidence of maritime voyaging and coastal resource use at 35,000–30,000 years ago (Fujita et al. 2016). Marine and freshwater shell and shell tools in these and later site deposits, including 23,000–19,000-year-old shell fishhooks, demonstrate aquatic resource use and the presence of early shell scatters.

In the Americas, shell middens were widespread by the Early to Middle Holocene, but research is helping understand the antiquity of coastal resource use and the peopling of the Americas (Erlandson et al. 2007). Evidence of the use of estuaries and kelp forests, marine shellfish, finfish, mammals, and birds has been documented in >12,000–10,000-year-old deposits from British Columbia, California's Channel Islands, and Baja California (Des Lauriers 2010; Erlandson et al. 2011; Fedje et al. 2001; Mathewes et al. 2020). In South America, layers of shell, bones, artifacts, charcoal, and other materials at Huaca Prieta are even older at 15,000–8000 years ago (Dillehay et al. 2017). Shell deposits elsewhere in Peru extend back roughly 13,200 to 11,200 years ago (Sandweiss 2003), and shell middens in northern Chile dated between ~12,900 and 9000 years ago (Béarez et al. 2015). On the other side of the continent, early shell midden layers in the Bolivian lowlands of western Amazonia and at a riverine shell midden in Brazil extend back ~10,000 years (Figuti et al. 2013; Lombardo et al. 2013). In parts of South and North America, shell middens tend to be younger and increased greatly after ~7000 years ago (Méndez et al. 2021; Reyes et al. 2022; Saunders et al. 2009; Zangrando 2018).

Given their conspicuous nature, shell middens are an obvious sign of people's interactions with aquatic habitats, their movements around the world, and colonization of offshore islands (Erlandson 2001; Marean 2014; Rowland et al. 2021). This includes sites dated to the Late Pleistocene, but it also is important for tracking later (Holocene) movements of people. On the Farasan Islands, Saudi Arabia, a region hypothesized as an area for potential migration between Africa and Asia, over 3000 shell middens primarily dated from 7360–4700 years ago have been discovered (Bailey and Flemming 2008; Hausmann et al. 2019). Despite their Holocene age, these sites have implications for how we interpret other early sites containing shellfish around the world.

Submerged Shell Middens and Paleolandscapes

Changes in sea level, especially the dramatic shoreline alterations that accompany interglacial and glacial cycles, had a profound influence on human use of coastal habitats and coastal archaeology. Sea level was lower than present for 95% of human history, meaning that much of the shoreline where people likely lived is currently submerged (Bailey and Hardy 2021b; Cook Hale et al. 2021). During the Last Glacial Maximum, sea level was roughly 120 m lower compared to the present, indicating that coastal processes strongly influence the formation, preservation, and discovery of shell middens (Bailey and Flemming 2008). Consequently, archaeologists have long been interested in reconstructing and modeling shoreline and sea level changes and conducting underwater research to reconstruct now submerged paleolandscapes and identify archaeological sites, including shell middens (Bailey and Flemming 2008; Faught and Smith 2021; Flemming 2021).

Shoreline modeling, subbottom profiling, and other techniques provide insights into past shoreline locations, submerged river channels, and other aspects of past landscapes that now lie on the seafloor (Faught and Smith 2021; Laws et al. 2020; Mackie et al. 2018). These studies yield information that can help predict where past human settlements and submerged archaeological sites may be located. This approach characterizes seven underwater site discoveries in the Americas, ranging from terminal Pleistocene lithic sites to Maya salt facilities, and shell middens (Faught and Smith 2021). Similar to shell midden research on land, a key aspect of underwater shell midden archaeology is focused on determining the potential cultural origin of submerged deposits (Cook Hale et al. 2021). A former hindrance to earlier underwater archaeological research is that many assumed that sea level rise and inundation would have destroyed most sites and rendered them indistinguishable from natural deposits (Anderson 2013; Bailey et al. 2020; Cook Hale et al. 2021). While the discussion here focuses on submerged marine sites (including a few intertidal sites), submerged sites are also found in freshwater lakes, including freshwater shellfish, nuts, and seeds submerged 2–3 m below the surface in Lake Biwa, Japan (Habu et al. 2011; Iba 2005).

Denmark has a remarkable submerged archaeological record, and archaeologists working in the region are leaders in underwater archaeology, with submerged sites dating to as early as 8500 years ago (Bailey et al. 2020). Most underwater sites in Denmark are in shallow water (2–5 m), with waterlogged and anaerobic conditions promoting excellent preservation of wooden objects, bone, and more. Excavations in the 1970s and 1980s built the foundation for underwater shell midden archaeology, including work at Tybrind Vig. This site contains remnants of fish weirs, log boats, human burials, cordage, faunal remains including oyster shell, and much more, some of which was found and preserved where it was abandoned in situ (Anderson 2013; Bailey et al. 2020). Despite over 500 shell middens on land and a comparable number of underwater sites in Denmark, submerged shell middens are rare, with much of the shell of questionable cultural origin (Bailey et al. 2020).

In Denmark, two underwater shell midden sites have been studied, excavated, and analyzed. At Hjarnø Sund, the excavation of box cores, automated scanning electron microscopy, and microstratigraphy determined high stratigraphic integrity of the shell midden, definitive cultural layers, and accumulation beginning around 7200 years ago (Skriver et al. 2017; Ward et al. 2019). About 400 m to the north, the Hjarnø Vesterhoved shell midden contains a deposit dated to between 7300 to 6300 years old (Fig. 4; Astrup et al. 2020, 2021).

Although shell middens have yet to be identified, the Dynamic Landscapes, Coastal Environments and Human Dispersals (DISPERSE) or Blue Arabia project is a systematic research program designed to investigate underwater paleolandscapes and search for archaeological sites in this important corridor of human dispersal (Bailey et al. 2015). The lack of shell middens may be the result of poor preservation conditions, including weathering and erosion while the sites were on dry land and during inundation that may make it difficult to identify these sites underwater. The Blue Arabia research, however, provides a framework for Southwest Asia and

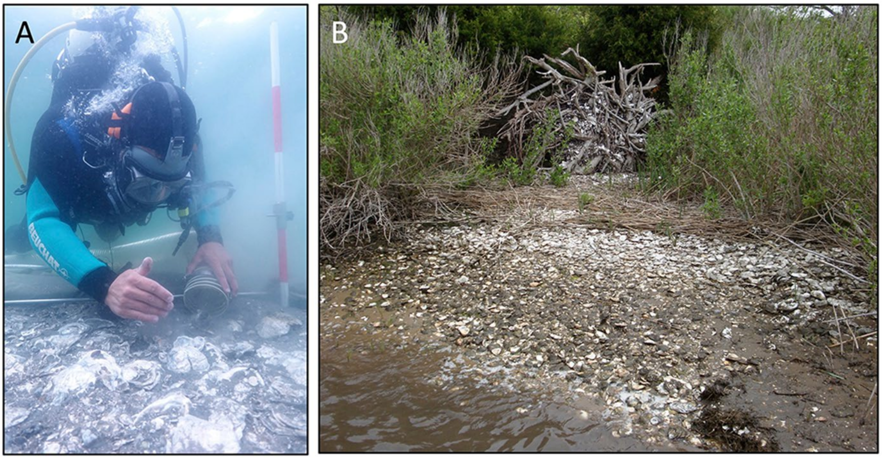

Fig. 4 Underwater and partially submerged shell midden archaeology: **A** investigations at Hjarnø Vesterhoved (photo adapted from Astrup et al. 2021); **B** Late Holocene shell midden exposed at low tide in Maryland. Note shell midden visible in base of tree overturned during a recent hurricane (photo by T. Rick)

beyond for understanding the marginality versus the productivity of coastal regions and the factors that inhibit underwater research (Bailey et al. 2015).

In North America, recent research at a submerged shell midden in the Econfina Channel, Florida, is one of the few other confirmed underwater shell middens in the world (Cook Hale et al. 2019, 2021, 2022). Sedimentological work at the submerged midden suggests that, like Hjarnø, the midden is anthropogenic. Together the Econfina and Hjarnø sites and a newly identified third midden at the Newton McGann site in Florida demonstrate that minimally invasive analyses can help discover additional underwater shell middens and that there may be greater numbers of submerged shell middens than previously presumed (Cook Hale et al. 2021, 2023). The Hjarnø Sund and Econfina middens are dated to just over 7000 years ago and 5500–3000 years ago, respectively. Although submerged research has the potential to document even older shell middens, some of this work needs to be done at greater water depth on older shorelines.

Other projects in western North America provide potential evidence of past shell middens. Near Isla Espiritu Santo in the Gulf of California, for example, an underwater deposit near several Early Holocene shell middens on land has been interpreted as a shell midden (Faught and Gusick 2011; Gusick and Davis 2010; Gusick and Faught 2011). Following shoreline modeling and review of several prospective locations, this likely shell midden was identified, tested, and excavated. Cobbles that were transported by people, oyster shells, and possibly chipped stone tools were identified along the ~9000-year-old shoreline (Gusick and Davis 2010; Gusick and Faught 2011). Subsequent research did not identify unequivocal cultural material, and radiocarbon dating of a shell was much younger than anticipated (see Faught and Smith 2021). These findings illustrate the challenges of underwater work and the difficulties highlighted by researchers in Denmark in attempts to identify clear cultural shell midden deposits underwater (Bailey et al. 2020). Similar challenges affect other areas, including Rhode Island where a purported shell mound was determined to be a natural deposit dated to 430–190 years ago (Jazwa and Mather 2014). In coastal Belize, analyses of a variety of characteristics of site constituents and formation, however, determined that a submerged midden there was deposited by humans, providing evidence of coastal resource use by the Classic Maya (~1700–1100 years ago) (Feathers and McKillop 2018; McKillop 2023).

Along the Northwest Coast of North America, underwater projects have been carried out for over 50 years, including studies from Prince of Wales Island to the Olympic Peninsula of Washington on shipwrecks and intertidal deposits, including shell middens (Easton et al. 2021). Research at an intertidal shell midden near Port Houghton, Alaska, produced abundant bone harpoons and harpoon points, slate points, cordage and wooden tools, and Pacific cod, mammal, and bird remains dated to around 2760–2500 years ago (Bowers and Moss 2001; Easton et al. 2021). With the recovery of submerged stone tools and other materials elsewhere in British Columbia (Mackie et al. 2018), including a submerged midden at Montague Harbor, future work holds great potential to discover submerged middens (Easton et al. 2021).

On California's Channel Islands, a comprehensive underwater program has recently been launched, expanding the reporting of artifacts found offshore in the region since the 1970s (Braje et al. 2019). Subbottom profiling and other approaches are reconstructing shorelines, information on water depth (bathymetry), and building models of past settlement and landscapes (Braje et al. 2022; Laws et al. 2020). The project has yet to identify definitive cultural deposits, but several possible locations have been identified along with new, important shoreline and paleolandscape reconstructions (Braje et al. 2019, 2022; Gusick et al. 2022; Laws et al. 2020).

The first confirmed artifacts identified on the continental shelf of northwestern Australia consist of >260 stone tools about 2.4 m below the surface, with other artifacts recently found in nearby waters (Benjamin et al. 2020, 2023). This work is complemented by work at other intertidal/submerged archaeological sites (Leach et al. 2021). These efforts also are part of broader work in South Africa, South America, and Australasia that demonstrate a growing emphasis on underwater research in the Southern Hemisphere (Ward et al. 2022). While the Australian, Californian, and other examples described here are just beginning, the examples from Denmark and Florida demonstrate that these investigations will be well worth the effort and could reshape our perspective of shell midden archaeology and coastal adaptations in the coming decades, especially the antiquity and history of human use of marine resources.

Historical Ecology and Human–Environment Interactions

The diverse faunal remains, archaeobotanical materials, sediments, and residues found in shell middens are key elements of research on a variety of issues about past environments and human ecology (Bailey and Parkington 1988; Braje et al. 2017a; Erlandson and Rick 2010; López de la Lama et al. 2021; Orton 2016; Robson et al. 2023; Szabó 2017; Waselkov 1987). Shell midden research and environmental archaeology are closely aligned, with archaeologists asking a wide range of questions about past, present, and future environments using a number of methodological advances in stable isotopes (Andrus 2011; Kwiecien et al. 2022; Misarti et al. 2017; West et al. 2018), ancient and environmental DNA (aDNA and eDNA; Der Sarkissian et al. 2020), zooarchaeological mass spectrometry (ZooMS; Harvey et al. 2019), chronological modeling and radiocarbon dating (Fernández-López de Pablo 2016; Hadden et al. 2023; Krus and Thompson 2019; Zazzo et al. 2016), mineralogy, scanning electron microscopy, and sediment micromorphology (Oertle et al. 2022; Villagran 2019), bioarchaeology (White et al. 2021), and much more (see Thomas 2015a, b). I focus on a subset of this work—historical ecology—specifically the use/application of environmental data from shell middens to understand contemporary issues in biological conservation or human–environment interactions (Crumley 2021; Erlandson and Rick 2010). Archaeological data are particularly useful for establishing ecological baselines for modern restoration, a theme discussed across geographic regions below (Lyman 2012; Wolverton et al. 2016).

A number of studies illustrate the importance of African shell middens for investigating human–environment interactions and contextualizing contemporary environmental issues during the Holocene (Crowther et al. 2016; Douglass and Cooper 2020; Douglass et al. 2019; Faulkner et al. 2022). For instance, archaeobotanical data that document Southeast Asian crops (Asian rice, mung bean, cotton, etc.) in shell middens on Madagascar and the Comoros provided the first direct evidence of an Austronesian colonization of Africa and concomitant environmental change about 1300–1100 years ago (Crowther et al. 2016). Reconstructions of shellfish communities in island east Africa also contribute to our understanding of historical ecology of finfishes and shellfish, including in Madagascar and the Mafia Archipelago (Douglass 2017; Faulkner et al. 2019). Shell midden research in the Mafia Archipelago provides baseline marine invertebrate data for the last 2000 years, with observed changes in shellfish perhaps resulting from environmental and cultural factors (Faulkner et al. 2019). In South Africa, research on Late Holocene megamiddens and other sites also helps us evaluate human–environment interactions, including size declines likely from human predation pressure on limpets and black mussels (Jerardino et al. 2008). Shell middens also are providing insights into human colonization and environmental interactions on the Canary Islands, including evidence for sustained limpet harvest during aboriginal occupation and for anthropogenic size declines during present-day harvest (de Nascimento et al. 2020; Mitchell 2023; Parker et al. 2020).

Research on shell middens in the Arabian Peninsula, including zooarchaeological and ethnobotanical data, documents the movement of domesticated and wild plants and animals in this region (Boivin and Fuller 2009). Maritime trade and interaction beginning in the Early to Mid-Holocene indicate some of the ways people were shaping the landscapes in which they were living and moving between on the peninsula (Boivin and Fuller 2009). Meanwhile on the Farasan Islands, measurement of lined conch shells from Holocene shell middens were compared to records of sea level rise and other environmental and cultural variables (Fig. 5; Hausmann et al. 2021). Despite intense harvesting between 7360 and 4780 years ago, these shells showed resilience to human predation, sustainable harvest, and no sign of depletion,

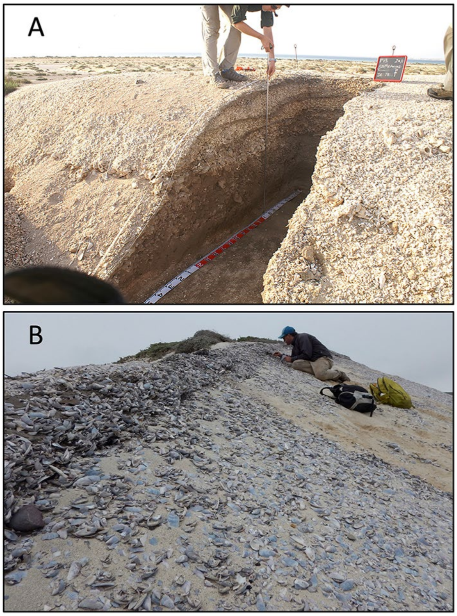

Fig. 5 Examples of shell midden sites that have played an important role in historical ecology: **A** large and dense Holocene shell midden on the Farasan Islands, Saudi Arabia at JE0078 (photo adapted from Hausmann et al. 2019); **B** a Late Holocene shell midden composed mostly of California mussel shell on San Miguel Island, California (photo by Todd Braje)

providing long-term baseline ecological data for this species (Hausmann et al. 2021).

In Europe, shell midden archaeology has long played a role in historical ecology, including the North Sea region, where shell middens figure prominently in research and human environmental impacts are often connected to other trends and developments like the spread of agriculture (Bailey et al. 2008). Similar to the African and Arabian cases, analysis of shellfish (e.g., oysters) from Danish shell middens tracks age/size decline in oysters across the Mesolithic-Neolithic transition, with at least some of this related to human predation pressure (Milner 2013). Greater oyster abundance and accumulation in Danish shell middens during two periods (7600–7100 and 6400–5900 years ago) of increased marine productivity may provide analogs for understanding and forecasting future change under different climatic and environmental productivity scenarios (Lewis et al. 2020; but see Hausmann et al. 2022). Beyond oysters, Danish shell middens contain an astounding array of marine resources, including haddock, great auk, shellfish and eels, and evidence of diverse maritime activities that further illustrate the diversity of human–environment interactions evident in shell middens (Fischer et al. 2021).

Elsewhere in Europe, shell midden research provides important perspectives on human–environment interactions and the historical ecology of fisheries (Barrett 2019; Colonese et al. 2011; Dupont and Marchand 2021; Gutiérrez-Zugasti et al. 2016; Llorente-Rodríguez et al. 2022; Mannino and Thomas 2002). A 20,000-year record of fish and shellfish in southern Iberia, for instance, tracks human influence on marine organisms through hunter-gatherer to later Roman occupation (Morales-Muñiz and Roselló-Izquierdo 2008). Shellfish size data through time also yield important information on the role of climate versus human predation pressure on shellfish in the Mediterranean and Iberian Peninsula (Colonese et al. 2014; Gutiérrez-Zugasti 2011; Mannino and Thomas 2002). For example, in Spain and Sicily climate and human predation during the Pleistocene-Holocene influenced observed shellfish size declines, patterns that echo perspectives from Denmark and other areas (Colonese et al. 2014; Gutiérrez-Zugasti 2011).

Human–environment interactions and historical ecology are important features of shell midden analysis in East Asia that cover a variety of issues from climate change to the origins of agriculture (Habu 2004; Habu and Hall 2013; Habu et al. 2011; Komatsu et al. 2022; Zhang et al. 2020; Zhao 2019). In the Philippines, faunal data from shell midden deposits at the Bubog I rockshelter, for instance, reveal people's changing use of marine and terrestrial resources following landscape changes from the terminal Pleistocene to Holocene (Boulanger et al. 2019). Phytoliths from freshwater shell middens in Guangxi Province, China, document landscape and environmental changes, including increased human use of palms during the Early Holocene (Zhang et al. 2020). Similar themes emerge from archaeobotanical and residue data from shell middens in Korea from 7500–4000 years ago, including widening diet breadth, use of terrestrial plants and animals, and exploitation of whales (Kim and Seong 2022; Kwak et al. 2022). Oriental clam size data from Jomon shell middens demonstrate some initial selective/sustainable harvest of oriental clams, but eventual predation pressure indicated by size declines, further illustrating the influence of past peoples on nearshore shellfish (Habu et al. 2011). Finally, integrated analyses of archaeological, historical, and paleoecological data, including material from shell middens, document accelerating human–environmental impacts in Japan from the Holocene to Anthropocene, including recent overfishing and globalization (Hudson 2022; Hudson et al. 2022).

To the north, long-term research in the Kuril Islands has established a complex human–environmental history, spanning millennia and drawing on rich zooarchaeological, chronological, and other data (Fitzhugh et al. 2016). Analysis of several shell and/or bone midden deposits, provide important information on human adaptations and lifeways in remote coastal settings, the interface of environmental and climate change and human activities, demographic fluctuations, and increasing globalization and interconnection (Fitzhugh et al. 2016; Gjesfjeld et al. 2019). When paired with data from Hokkaido and Alaska, the Kuril Islands research documents Middle to Late Holocene climatic changes with implications for climate and environmental change today (Fitzhugh et al. 2022).

Elsewhere on the Pacific Rim, long-term research in Alaskan shell middens has supplied information on climate change and human–environment interactions, drawing on zooarchaeology, stable isotope studies, and food network analyses (Dunne et al. 2016; Misarti et al. 2009; Moss 2011). Arctic ground squirrel bones from Chirikof Island sites, for example, reveal past squirrel translocations by humans and implications for contemporary conservation (West et al. 2017). A number of studies focus on clam gardens—modified coastal landscapes that increase clam habitat—and associated shell middens that can help define site activities and chronologies, establish trends in past environmental stewardship by Indigenous people, and foster collaboration with Indigenous communities (Holmes et al. 2022; Lepofsky et al. 2015; Tonielo et al. 2019). Dozens of clam gardens were built on Quadra Island, British Columbia, often associated with large settlements and shell middens particularly between about 3800 and 2000 years ago, with a dramatic decline during European colonization (Holmes et al. 2022).

Other studies in Alaska and British Columbia highlight changes in birds (Funk 2018) and finfishes found in shell middens that interface with environmental and cultural developments (McKechnie and Moss 2016; McKechnie et al. 2014). Sea otters recovered from eastern Pacific shell middens are a focus of historical-ecological research from Alaska to Baja California and demonstrate research connections across this vast region. Analyses of sea otter bones from Pacific Coast shell middens include investigating genetic relationships and strategies for reintroduction (Wellman et al. 2020), kelp forest ecology and foodwebs (Elliott Smith et al. 2020; Szpak et al. 2012), Indigenous hunting rights (Moss 2020), and relationships between people, sea otters, and marine ecosystems over millennia (Braje et al. 2011; Slade et al. 2022).

Historical-ecological research on shell middens in California covers a range of topics beyond sea otters, from intertidal shellfish exploitation to reestablishing Indigenous environmental stewardship and documenting long-term trends in the harvest of birds, mammals, fishes, and other organisms (Braje et al. 2017a; Broughton 2002; Erlandson and Rick 2010; Jones et al. 2008; Lightfoot et al. 2021). Analyses of shellfish size data from across California, especially California mussels and red and black abalones, have documented size declines, evidence of sustainable harvest, and connections to changing climatic conditions (Erlandson et al. 2008; Glassow 2015; Whitaker 2008). Along with research on other marine invertebrates (Ainis 2020; Thakar 2012), analysis of abalone provides some of the best connections between archaeological data and contemporary conservation and restoration, including implications for determining the best location for shellfish restoration projects (Braje et al. 2015). In addition to shellfish, analyses of nearshore forage and kelp forest finfishes have provided insight into the ecological services of fishes and people and contemporary baselines for conservation (Braje et al. 2017b; Palmer et al. 2018; Sanchez et al. 2018a). Similarly, studies of the long-term relationships between people and seals, sea lions, sea otters, flightless ducks, and other species have tracked human impacts on the environment and ecological change that also contextualize contemporary recovery efforts (Braje et al. 2011, 2017a; Erlandson et al. 2015; Jones et al. 2021; Radde 2020; Rick et al. 2013). This research extends to human interactions with terrestrial ecosystems, with shell midden analyses contributing to understanding translocations of island foxes and other species (Hofman et al. 2016; Rick 2013) and the sustainable harvest of geophytes and other plants (Gill et al. 2019).

Though less well documented than Alta California, United States, recent research at shell middens on the desert coast of Baja California, Mexico, complements and enhances research in other regions. Isotope analysis of otoliths from the endangered totoaba fish recovered from Baja California middens, for example, provides insight into past sea surface temperature and context for understanding the conservation of this fish today (Ainis et al. 2021). On the Pacific Coast of Baja Peninsula, zooarchaeological data from a shell midden and paleoclimatic reconstructions document how El Niño-Southern Oscillation influenced human subsistence and ecology (Broughton et al. 2022).

Comparable to oyster research in Denmark and beyond, on the Atlantic Coast of North America meta-analyses of eastern oyster size through time from shell middens, historical reef locations, and modern oyster measurements have yielded long-term perspectives on the resilience and sustainability of these fisheries (Rick et al. 2016; Thompson et al. 2020a). Other studies of oysters in the region uncovered declines in large-sized oysters, general size declines through time on smaller regional or site-specific scales, and potential evidence for management and long-term stability (Hesterberg et al. 2020; Jenkins 2017; Jenkins and Gallivan 2020; Lulewicz et al. 2017; Savarese et al. 2016). Beyond oysters, long-term historical-ecological research at shell middens and mounds along the Florida Gulf Coast and Florida Keys document a variety of interactions with marine and terrestrial ecosystems and organisms, including fish capture, the management and the use and exchange of cultigens, and evidence for long-term sustainable harvest (LeFebvre et al. 2022; Marquardt and Walker 2013; Thompson et al. 2020b). Stable isotope analysis and zooarchaeological data from shell middens in the Southeast also underscore the fluctuating temporality/seasonal harvest patterns of oysters, fishes, and other organisms, adding additional context for interpreting human–environment interactions (Hadden et al. 2022; Holland-Lulewicz and Thompson 2021; Lulewicz et al. 2020).

While coastal regions of North America are centers of historical ecology and shell midden research, studies of middens on interior portions of North America, particularly of freshwater shellfish, play an important role in historical ecology and applied zooarchaeology (Wolverton et al. 2016). Mussel shells identified from midden sites in Mississippi contain species that are rare, endangered, or extinct in some waterways today, indicating changes in riverine ecosystems and providing baselines for conservation and restoration (Mitchell and Childress 2021). Other studies have tracked freshwater mussels from Alabama to Texas, including changing species dynamics that confront perceived limitations of historical ecological/applied zooarchaeological data and provide baselines for changing species compositions today (Peacock et al. 2012; Wolverton et al. 2016).

Biodiversity-rich tropical islands are key areas for conservation today, with those in the Caribbean demonstrating centuries to millennia of people's influence on island ecosystems, especially mangroves, coral reefs, littoral habitats, and terrestrial ecosystems (Fitzpatrick and Giovas 2021; Siegel 2018; Wake et al. 2013). While there is evidence for human-induced size declines in shellfish and finfish, recent work on marine gastropods and coral reef finfishes reveals long-term sustainability in resource use in Caribbean Island shell midden assemblages (Giovas 2021; LeFebvre 2007). Moreover, translocation/movement of animals and plants around the Caribbean show how people shaped local ecosystems, with many of these finds coming from zooarchaeological, ethnobotanical, and genetic work on samples obtained from shell middens (Giovas 2019).

In South America, synthesis of some 110 Brazilian sambaquis dated from 5500–370 years ago has helped establish how archaeological data inform conservation and management (Fossile et al. 2020). Comparison of some of these archaeological data to modern fish catches indicates significant declines between ancient and modern fish sizes (Fossile et al. 2023). Data from sambaquis also uncovered people's broader land use patterns, including evidence for low-level food production and gardening, with others chronicling long-term cycles of drought-tolerant fishes (Prestes-Carneiro et al. 2020; Scheel-Ybert and Boyadjian 2020) and resource management and territoriality between coastal and interior habitats in Argentina (Mansur and Piqué 2013). Research In Tierra del Fuego and the Beagle Channel used stable isotope analysis of pinnipeds (seals and sea lions), marine fishes, and seabirds to create long-term records of climate and environmental change, illustrating that people were a driving force in Holocene marine foodwebs and ecosystems (Bas et al. 2019; Nye et al. 2020). On the arid north coast of Chile, shell midden research has documented a 7400–5900-year-old offshore marlin and swordfish fishery, with isotope data from some of these specimens providing a baseline record of mercury content (Béarez et al. 2016; Biton-Porsmoguer et al. 2022).

A central part of historical-ecological research is determining the effects of natural climatic changes from anthropogenic forcing, a topic explored using data from several South American shell middens (Sandweiss 2003; Sandweiss et al. 2020). Shellfish from midden deposits at Moche sites in Peru document the interplay of both El Niño and human activities on driving changes in shellfish size (Warner and Alaica 2022). Geoarchaeological analyses in shell midden sediments in Peru also have documented a massive tsunami in the area around 3800 years ago (Salazar et al. 2022). The composition of shell middens and other data from Brazilian sambaquis also indicates changes in sea level rise and establishes a context for understanding future change (Villagran and Giannini 2014).

Issues of anthropogenic and natural climatic forcing are guiding research in the Indo-Pacific and eastern Pacific as well. For example, shellfish size, morphometrics, or life-history information through time depict complex relationships between people and nearshore marine ecosystems, including evidence of overharvesting and sustainability present in shell midden sites from Papua New Guinea to Micronesia, Australia, New Zealand, and remote islands (Allen 2012; Ash et al. 2013; Faulkner 2014; Faulkner et al. 2020; Fitzpatrick and Giovas 2021; Giovas et al. 2010; Monks 2021; Seeto et al. 2012; Thomas 2019; Traversat et al. 2023; Ulm et al. 2019). Similar to the North American midcontinent, this includes work at Australian interior freshwater shell middens, where the use of small shellfish, previously thought to be bycatch, are an important component of human subsistence and environmental interactions (Garvey 2017). Comparative analysis of fish remains from throughout the Pacific Islands, including specimens from shell middens, also demonstrates long-term patterns of resource use, including overexploitation and implications for fisheries management and conservation (Lambrides and Weisler 2016). The Shag River site in New Zealand, with its bone beds rich in bird and seal remains, overlying shell midden, and architectural features, is a classic example of how intensive research at a site complex and regional comparison can document the extinction of the giant moa, declining use of seals and sea lions, and fluctuating use of finfishes and shellfish (Anderson 2008; Anderson and Smith 1996; Nagaoka and Allen 2009). Still other shell middens contain archaeobotanical data that document the introduction of the sweet potato throughout New Zealand (Barber and Higham 2021), as well as

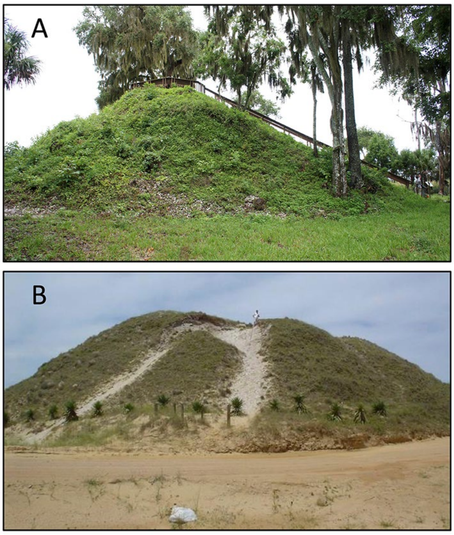

Fig. 6 Shell mound sites in the Americas: **A** massive mound at Crystal River in Florida (photo by Victor Thompson); **B** sambaqui in southern Brazil (adapted from DeBlasis et al. 2021)

plant microfossils and parasites useful for tracking human–environmental impacts (Horrocks et al. 2023).

Collectively, these data highlight the myriad ways that archaeologists around the world use data from shell middens to help understand long-term human–environment interactions in the past and enhance biological conservation in the present. This is an important development in research and is central to expanding the future relevance of shell midden archaeology.

Terraforming, Shell Mounds, and Megamiddens

Large shell mounds and middens are found around the world and often make up unique landscapes, including human burials and other ceremonial and symbolic aspects, that can cover several kilometers and stand several meters tall (Fig. 6; Grier and Schwadron 2017; Lightfoot and Luby 2012). Recent research on shell mounds has drawn on the concept of terraforming to conceptualize the making of shell mounds and other anthropogenic works. According to Grier and Schwadron (2017, p. 5), "[t]erraforming is a practice that involves the manipulation, alteration or construction of elements of the landscape by moving physical materials." The term 'terraforming' comes from science fiction futurism and the construction of new landscapes on Mars and beyond (Randall and Sassaman 2017; Schwadron 2017). In coastal areas, shell is often used in the construction of large mounded landscapes, with the concept of terraforming helping guide and evaluate the formation of shell middens and the ways people modified land and seascapes around the world for thousands of years.

The shell mounds of the American Southeast are a focus of research, providing insights into the nature of terraforming, hunter-gatherer sociopolitical organization, mortuary and ritual practices, and other topics (Sassaman 2004). Shellfish have been harvested by people in Florida throughout the Holocene, including freshwater shellfish for over 9000 years and marine species for some 7000 years (Randall and Sassaman 2017; Saunders and Russo 2011). By the Middle to Late Holocene (Late Archaic), people were building large mounded sites from South Carolina to the Florida Gulf Coast, including sites variously termed shell rings, mounds, and works (Marquardt 2010; Sassaman 2004; Schwadron 2017; Thompson 2022; Thompson and Worth 2011). While the function and meaning behind these sites are debated, shell mounds had diverse functions and origins, ranging from ceremonial and ritual contexts to political structures, raising the surrounding landscape above sea level, and possibly helping capture freshwater (Marquardt 2010; Sassaman 2004; Schwadron 2017).

On Florida's Gulf Coast, the Crystal River and Roberts Island mounds chronicle the construction of monumental shell mounds and their relationships with people's broader use of the landscape (Fig. 6). Archaeologists working at these sites employed remote sensing, radiocarbon dating and modeling, isotope studies, and other analyses to unlock complex patterns and relationships (Pluckhahn et al. 2015; Thompson 2022). One of the Roberts Island mounds is a stepped pyramid made of massive amounts of oyster shell and other material that stood 4 m tall and was constructed between about 1200 and 1000 years ago (Pluckhahn et al. 2016).

At the Shell Mound site, north of Crystal River, mound construction has key ceremonial and ritual aspects, with the shell mound forming part of a civic-ceremonial center that was incorporated into a diverse set of sites, activities, and use of the broader landscape (Sassaman et al. 2017). Comprised primarily of oyster shell, Shell Mound is 170 x 180 m and up to 7 m tall enclosing a "plaza-like" space 60 m in diameter (Sassaman et al. 2020). Shell Mound dates to 1600–1350 years ago, with this massive complex built in a 250-year period and likely timed to ritual activities associated with the summer solstice (Sassaman et al. 2020).

To the south, Mound Key highlights the ways in which shell mounds and works figured into political systems (Marquardt et al. 2022; Thompson et al. 2016, 2018). Mound Key was home to the capitol of the powerful Calusa kingdom of southwest Florida. At Mound Key, Pineland, and other sites, shell mounds and works represent subsistence foods at a basic level, but at Mound Key the shell and earthen mounds served as a base and platform on which structures were built for the Calusa elite (Thompson et al. 2016, 2018). Beginning around 1000 years ago, a monumental shell mound was constructed at Mound Key that included water courts or fish traps, all part of a complex ritual and engineered coastal landscape (Marquardt et al. 2022).

Further emphasizing the patterns of terraforming landscapes, the shell works of the Ten Thousand Islands region contain unique depositional histories from diverse middens to "clean" shell deposits (Schwadron 2017). These include shell rings, mounds, and works in a wide variety of deliberately constructed shapes, including water courts dated to the Middle and Late Holocene. These findings further demonstrate that shell mounds and middens are not merely refuse but represent the relationships people had with each other, their communities, and the ocean (Schwadron 2017).

The St. Johns River area of northeastern Florida, where freshwater shell and sand mounds were built for over 7000 years, underscores the diverse nature of terraforming (Randall and Sassaman 2017). Some shell ridges in the region are 200 x 100 m in area and others are 300 m or more in length, with over 75,000 m^3 of material, an enclosed spring, and evidence of mortuary activity and ritual (Randall and Sassaman 2017). Terraforming and shell middens in interior Florida document changing social and environmental contexts where the past is memorialized and people created new opportunities for the future (Randall and Sassaman 2017).

Shell works, mounds, and rings in Georgia and South Carolina also are key parts of the terraforming tradition in the American Southeast (Sassaman 2004; Thompson and Worth 2011). At the Sea Pines site in South Carolina, for instance, ancestors were cremated along with animals and buried in a reuse of the older site deposits, suggesting relationships between people and past and present landscapes as revelatory locales (Sanger 2021; Sanger et al. 2021). On the Georgia Coast, stable isotope analyses of shells from the Sapelo shell ring are fruitful for understanding the year-round occupation of the site and adding another critical piece to understanding people's use of the broader landscape (Thompson and Andrus 2011). Long-term research on St. Catherine's Island has produced a wealth of archaeology on topics ranging from historical occupations to early shell midden and mound formation, and the seasonality of shellfish harvest (Cannarozzi and Kowalewski 2019; Colaninno 2022; Sanger et al. 2020; Thomas 2008).

In several other parts of the world, people also built large shell mounds. Large shell mounds characterize the San Francisco Bay region and have been a focus of research since the late 1800s, but many of these have been destroyed by mining and construction activities. San Francisco Bay mounds often accumulated over millennia and were not necessarily purposefully constructed, but they still held important meaning for local peoples and often contain human burials (Lightfoot et al. 2017; Luby et al. 2006). Terraforming practices and modified landscapes also are apparent in Northwest Coast sites that are over 5000 years old, with these activities accelerating around 1500 years ago (Grier et al. 2017). A wide variety of large shell middens and mounds are present in southern California (Braje et al. 2014), including the El Montón site on Santa Cruz Island that is 270 x 210 m in area and contains 50 house depressions, cemeteries, a ceremonial dance area, and evidence for other ritual practices (Gamble 2017).

The sambaquis of Brazil are part of broader engineered landscapes (DeBlasis et al. 2021; Fish et al. 2013; Klokler 2017; Villagran 2014; Villagran et al. 2011). From 4000–2000 years ago, monumental shell middens, some over 50 m high, were created in Brazil (Fig. 6; DeBlasis et al. 2021). Interdisciplinary research demonstrates that, similar to the massive mounds in San Francisco, many of these sites have a prominent mortuary function but likely formed over a shorter time interval (Klokler 2017; Villagran 2014; Villagran and Giannini 2014). In addition to massive shell mounds, there also are "fishmounds" that contain a preponderance of fish bones, human burials, and pottery (Villagran 2014). Similarly, on the Pacific Coast in Peru, 4.5 m of shell midden strata accumulated in a large mound in just 500 years,

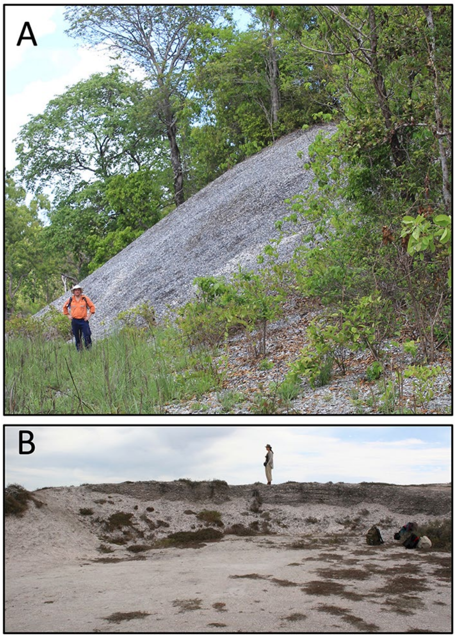

Fig. 7 Shell mound and megamidden in the Southern Hemisphere: **A** massive shell mound in northern Australia (photo adapted from Holdaway et al. 2017); **B** megamidden in South Africa (photo adapted from Jerardino and Navarro 2018a)

with prepared floors and evidence for abandonment phases (Beresford-Jones et al. 2022).

In southwestern Mexico, a series of shell midden islands made by Chantuto peoples primarily during the Middle Holocene provide other evidence of large mound construction and landscape alteration (Voorhies 2015). Voorhies (2015) investigated Tlacuachero dated to 5500–4500 years ago and other mounds in the region, referring to them as mega-mounds, comparable to the southeastern, San Francisco Bay, and Brazilian sites. While there is a need for greater attention to sedimentary geology and site formation, mega-mound sites have both unintentional (food remains) and intentionally constructed deposits and contributions from natural sources (Voorhies 2015).

In South Africa, megamiddens are another type of large shell midden that are prominent features on the landscape (Jerardino 2010, 2012; Parkington 1976). Dating between 3000 and 2000 years ago, these sites are generally around 12,000 m^2 in area and up to 2 m deep. Megamiddens are different in character than the American Southeast, San Francisco, and Brazilian mounded landscapes in that they tend to be dispersed over larger horizontal areas (Fig. 7; Jerardino 2012). Zooarchaeological analysis of faunal remains from the sites indicate that both marine and terrestrial resources were being exploited, with the sites located near rocky platforms and kelp forests providing access to marine resources and evidence for immediate consumption and drying for delayed consumption (Jerardino and Navarro 2018a, b). Analysis of these assemblages suggest that they may contain evidence for intensification and overexploitation of black mussel, limpets, and other resources (Jerardino 2012). The seasonal versus year-round nature of the site occupations and intensification models proposed by Jerardino and colleagues have been the subject of debate, but these sites clearly represent middening activities and complex relations with both marine and terrestrial ecosystems (Jerardino and Navarro 2018a, b; Parkington et al. 2015). Elsewhere in Africa, shell middens in Senegal and Gambia are often large mounds that contain evidence of burial and social practices and rich environmental records (Holl 2022; Thiam 2013).

While working on Australian shell mounds and focusing on their depositional rates and histories, Holdaway et al. (2017) coined the term ‘mound phenomenon’ to encapsulate the shell mounding in California, American Southeast, megamiddens, and sambaquis (Fig. 7). A large assemblage of 200 dates from 70 shell midden sites in the Albatross Bay region in northern Australia provides a database for understanding human–environment interactions and other behaviors (Holdaway et al. 2017; Morrison 2013). This research has documented massive shell mounds 10 m (or more) tall and composed primarily of granular ark shells, dated from 4000 to <500 years ago with complex depositional histories (Holdaway et al. 2017; Shiner et al. 2013). This diversity is further illustrated in the Torres Straight where shell and/or bone mounds, some with significant amounts of fish, dugong, and marine turtle, are intertwined with ritualized middening and people’s daily lives (McNiven 2013, 2016).

Large shell mounds also are found in Asia and Europe, demonstrating the global distribution of large shell mound sites and ritualized middening practices. An intensive program focused on Jomon shell middens in Japan reported hundreds to thousands of sites, many of which are shell middens (Habu 2004; Habu et al. 2011), including large shell mounds like the Late Jomon Nakazato shell midden in Tokyo with a 4.5-m-thick deposit of oysters, clams, and other constituents that may have functioned as a special purpose shellfish-collecting/processing site (Habu et al. 2011, pp. 23). Some Jomon shell middens contain human burials that are part of broader ceremonial and ritual systems like those documented at shell mound sites in other regions (Matsumoto 2018). Early and Middle Jomon middens with burials tend to be larger than later sites, with many of these located near other settlements with pit-dwellings (Habu et al. 2011).

Shell middens in Southeast Asia also comein a diversity of types and forms, with many containing human burials, like the Guar Kepa shell mounds in Malaysia that are 1 m or more deep (Rahman et al. 2019; Tieng 2015). Interior and coastal middens in Vietnam include the multicomponent coastal Middle Holocene mound at Thach Loc and a series of interior middens with land snails and evidence of environmental and cultural change (Grono et al. 2022; Rabett et al. 2011). In the Philippines, roughly 30 shell middens in the Cagayan Valley that are 1–2 m tall are comprised of massive quantities of freshwater clams (Amano et al. 2021; Thiel 1983). In the Andaman Islands, Cooper (1997) described abundant Late Holocene shell middens with diverse constituents and function, including mounds 2.5–4.5 m high. In Sri Lanka, shell middens have produced human burials and evidence of interior and coastal foraging (Roberts et al. 2022).

In Europe, shell middens in Denmark are often 1–2 m deep, while middens in Portugal (Muge) reach 4–5 m deep (Anderson 2000). Comparable to sites in Asia and elsewhere around the world, some Muge middens are more than 2500 m^2 in area and 5 m deep with posthole features and human burials (Bicho et al. 2010). All of these large shell middens and mounds from across the Americas to Australia, Asia, and Europe are just a few examples of the importance of shell middens in peoples' landscape alterations, ritual systems, memory, and creation that are well positioned for regional and global comparative analyses.

Landscape Legacies

For decades archaeologists have noted that soil conditions and plant communities on shell middens often significantly differ from areas adjacent to the archaeological deposits (Hrdlicka 1937). Studies of plant communities and soil conditions on shell middens have become increasingly sophisticated and have a wide range of implications for understanding the distribution and conservation of plants and the spread of invasive species. Some researchers have suggested that the anthropogenic soils and associated influence on biotic communities on shell middens could be a marker of the proposed geologic epoch the Anthropocene (Erlandson 2013). While similar landscape legacies occur in terrestrial areas with no contribution from shell middens, the research paradigms established in shell midden sites help evaluate the linkages between past human activities and land use and present-day biotic communities (Armstrong et al. 2018, 2021; Lepofsky et al. 2017; Trant et al. 2016).

In the 1930s, two studies were among the first to document the linkages between shell midden/coastal village sites and unique soil conditions and plant communities. While working at shell middens and villages on the Aleutian Islands and Kodiak Island, Hrdlicka (1937) concluded that the soil conditions and biotic communities at these sites were distinct from the surrounding area. A year later, similar patterns were described at inland shell middens in Baja California that differed significantly from the surrounding landscape (Meigs 1938). The Baja California sites are covered with ragweed and sage brush that contrast with agave, cactus, and annuals that characterize the surrounding landscape. People in the past may have unintentionally introduced burrs and seeds from plants while traveling across areas where the plants found at sites occur (Meigs 1938).

In the 1970s, Sawbridge and Bell (1972) provided a systematic investigation of landscape legacies by investigating 23 middens and plant communities on and off nearby shell middens in British Columbia. This study is one of the few to conclude that there were limited differences between plant communities on and off shell middens, especially if these areas shared similar topography. Furthermore, Sawbridge and Bell (1972) argued that calcium, nitrogen, and other nutrients decline as the age of the site increases.

British Columbia has been a center of landscape legacy research during the past 10 years, including shell midden sites and interior village sites, most of which stand in contrast to some of the patterns noted by Sawbridge and Bell (1972). For instance, examination of archaeological and nonarchaeological control sites demonstrated that people's actions had a strong influence on plant communities growing on British Columbia shell middens across 6000 years (Trant et al. 2016). Elevated calcium and phosphorus and other variables promoted taller and healthier red cedar trees, with shell midden soils and nutrients enhancing forest growth (Trant et al. 2016). Research at ten additional archaeological sites and ten nonarchaeological control sites further illustrated that shell middens allowed for a variety of plants to flourish, including a greater number of culturally significant plants (Fisher et al. 2019). Similarly, Schang et al. (2022) also demonstrated that species composition, tree height, and regeneration are all influenced by shell middens and habitation sites.

Cox et al. (2020) placed the influence of human activities on soil and biotic communities at Northwest Coast shell middens into a framework that emphasizes the subsidies that marine shellfish deposited on land make to terrestrial ecosystems. Here, the role of people in depositing shellfish at shell middens sites is compared to the creation of shellfish deposits by otters, birds, and other organisms, all of which provide varying influence on the landscape.

In one of the most comprehensive and diverse studies of the influence of people on past ecosystems and the ensuing landscape legacies of the present, Armstrong et al. (2021) investigated plant functional traits at forest garden and village sites, including one shell midden in British Columbia. Greater functional trait and plant diversity was identified in forest gardens than in surrounding forests. Even after human activities ceased for more than a century, forest gardens continued to provide important ecological functions and services, including resources and habitat for animals and pollinators (Armstrong et al. 2021). At forest gardens, people translocated organisms and tended garden sites, with significant influence on the landscape persisting after people were removed in the wake of settler colonialism. Forest gardens, however, do appear to have greater susceptibility to invasive species like Himalayan blackberry.

Through a comprehensive archaeological and ecological analysis in Nuchatlaht (Nuu-chah-nulth) territories on Nootka Island in British Columbia, Armstrong et al. (2022) inventoried 57 sites, with detailed work at 16 of them. Shell middens were an important part of the study with investigations of plant communities and other variables on shell middens, in orchard sites, and control sites. Plant communities at some of the shell midden sites were distinct from both orchard and control sites, and "wild" plant communities in these landscapes are the legacies of historical cultivation (Armstrong et al. 2022).

Working on the northern coast of Alta California, Karalius and Alpert (2010) provided an analysis of shell midden sites that suggests these sites had a higher percentage of invasive taxa that may be due to the higher nitrogen levels in midden soils, a pattern identified to a smaller extent by Armstrong et al. (2021) in British Columbia. In Baja California, Mexico, Vanderplank et al. (2014) found significantly different soil conditions at shell midden sites with aragonitic soils that also harbor unique native plant diversity.

Landscape legacies are apparent from the North American Gulf Coast to the Southeast and the Middle Atlantic region. For instance, the Coquile site in Louisiana is an earthen mound and shell midden with freshwater clams that rises above the surrounding swamp and marsh (Dunn 1983). The site contains significant quantities of native plants, including many known to be medicinal and/or of use to Native Americans, suggesting that many of the plants were introduced by Indigenous people. In Florida and South Carolina, differences in soil conditions and plant communities also occur at shell rings and mounds and on middens where over 95% of the plants were native (Stalter and Kincaid 2004; Stalter et al. 1999). This contrasts with the high number of invasive species noted on some Alta California shell middens (Karalius and Alpert 2010).

In North America's Middle Atlantic Coast, other studies have explored the relationships between shell middens and biotic communities, especially along the Chesapeake Bay. Investigation of 14 shell middens in Maryland identified 202 native species and varieties of vascular plants (McAvoy and Harrison 2012). The soil conditions of these middens differed significantly from adjacent non-midden areas that had lower nutrients. Shell midden sites dated from 3000–200 years ago near the Rhode River, Maryland, appear to have higher native plant species regardless of the age of the site (Cook-Patton et al. 2014). Midden sites here also have increased ground cover, elevated calcium and nitrogen, and greater herbaceous species.

These studies of shell midden landscape legacy illustrate the profound influence that past human activities have on contemporary landscapes and the subsidies provided by depositing shellfish and other foods at shell middens and habitation sites. This body of research underscores the linkages between people and nature and the dual conservation priority of preserving biodiversity, cultural sites, and associated landscapes (Vanderplank et al. 2014). When placed in the context of terraformed shell middens and mounds, people clearly left indelible marks on the landscape and influenced surrounding ecosystems into the present. Shell midden archaeologists have an important role to play in helping restore the connections between Indigenous peoples and plant communities in the present and future (Armstrong et al. 2021).

Climate Change, Coastal Erosion, and the Curation Crisis

The Erosion of Shell Middens and Coastal Heritage

Shell middens and the collections derived from them face a variety of ongoing challenges and threats, including sea level rise and marine erosion that are exacerbated by climate change and are destroying shell middens and coastal heritage sites around the world (Erlandson 2008). McGovern (2018) likened the threats from climate change to archaeological sites to burning libraries, with the destruction of archaeological sites and shell middens resulting in catastrophic loss of knowledge around the world. Erlandson (2008), McGovern (2018), Dawson et al. (2020), and others have urged scholars and the public to take action to address the loss of coastal cultural heritage through excavation, radiocarbon dating, and/or documentation of threatened sites and increased funding for such research.

An initial step in evaluating the effects of sea level rise on archaeological sites involves desk-based modeling and vulnerability studies, with many modeling sea level rise through time and some forecasting future threats to sites (Li et al. 2022; McCoy 2018; Reeder-Myers 2015; Westley et al. 2022). Along the Atlantic and Gulf Coasts of the southeastern United States, for example, Anderson et al. (2017)

indicated that over 13,000 recorded archaeological sites and many more unrecorded sites could be lost by 1 m of sea level rise in the coming decades. Vulnerability models are also used to assess potential effects of hurricanes and other severe weather events. In the Caribbean, Rivera-Collazo (2020) revisited a previous model in the wake of Hurricane Maria that devastated Puerto Rico. A pedestrian survey of 11 km of coast found that the vulnerability model significantly underestimated the impacts of the hurricane, with two sites predicted to be affected but eight actually impacted (Rivera-Collazo 2020). In Baja California, Vellanoweth et al. (2022) used photogrammetry/video to explore the effects of coastal erosion on a multicomponent shell midden, with mass wasting of site constituents corresponding to lunar-driven spring tide cycles. In the Farasan Islands of Saudi Arabia, sea level rise is noted as a threat to sites today and may also pose significant biases to specific types of sites (e.g., processing sites) that can influence interpretations (Hausmann et al. 2019).

Others have taken to action on the ground. The global and urgent nature of coastal erosion affecting a range of historical and prehistoric sites from shell middens to castles from Scotland to Florida is being combatted by citizen science programs (Dawson et al. 2020). For others, the threats of erosion render coastal archaeology to be effectively a recovery effort working against the rising tide (Fitzpatrick and Braje 2019). In this approach, research projects can be guided by sampling and basic data gathering at threatened sites before they are lost (Erlandson 2008; Fitzpatrick and Braje 2019; McGovern 2018).

Through multiscalar survey (i.e., LiDAR, traditional archaeological survey, and micro-artifact approaches), Davis et al. (2020, 2021a) provided a means to investigate disappearing landscapes and associated evidence of human occupation, including shell middens in the American Southeast. The approach needs further testing but did identify new shell mounds and other shell-bearing sites, with LiDAR highlighting locations that may have been difficult to locate by other means due to dense vegetation cover. In the Rhode River, extreme low-tide winter surveys by kayak were performed to locate archaeological sites, including shell middens inundated or partially submerged by high seas in the past century or so (Reeder-Myers and Rick 2019). Covering just over 23 km of shoreline, this project identified 15 new shell middens and rediscovered sites recorded decades earlier that had not been identified during subsequent terrestrial surveys. Despite growing concern about marine erosion, sea level rise and climate change-induced threats to the coastal archaeological record remain the greatest challenge facing shell midden preservation today.

The Curation Crisis and Value of Legacy Collections

Museums and repositories around the world care for and maintain collections of archaeological material from shell middens and other sites that are crucial for providing future research, education, community collaboration, and outreach opportunities. Analyses of legacy collections provide an ethical approach to archaeology that emphasizes working with extant collections rather than obtaining new collections, a practice in line with the concerns of many Indigenous communities. Despite the value of archaeological collections, however, we are in the midst of a curation crisis, where collections are threatened by underfunding, staffing shortages, space limitations, climate change, and other processes (Kersel 2015). As archaeologists argue for generating salvage collections to fight marine erosion, key questions remain about where these collections will be curated and how the next generation of collections stewardship will align with Indigenous community perspectives.

The curation crisis is amplified for shell middens because of the massive volume of material that shell middens contain. St. Amand et al. (2020) underscored the value of legacy collections to climate change and environmental research, describing work with collections from shell middens. This study discussed legacy collection work on the Maine coast, which provides research opportunities and Indigenous community access. Building on a foundation of community archaeology, the Maine research established a Memorandum of Understanding between the University of Maine and Penobscot Nation, prioritizing Indigenous stewardship and collaboration (St. Amand et al. 2020). This project demonstrated the many interrelated issues in curating archaeological legacy collections, including access, storage, funding challenges, limited field notes and documentation, and collaboration with descendant communities.

Analysis of legacy collections from a complex of shell midden sites near Seaside, Oregon, excavated in the 1960s and 1970s, provides a good example of the value of collections-based research, including chronology building and historical ecology (e.g., Losey and Yang 2007; Sanchez et al. 2018b, 2022; Wellman et al. 2020). At two of these sites (Par Tee and Palmrose), massive Late Holocene shell middens and material from over 500 excavation units at the Par Tee site alone contributed to numerous internships, dissertation and Master's projects, and postdoctoral fellowships (e.g., Colten 2015; Elliott Smith et al. 2022; Grindle et al. 2021; Loiselle 2020; Losey and Yang 2007; Sanchez et al. 2018b; Wellman et al. 2020).

The Par-Tee and Gulf of Maine examples are just a few of the projects being conducted on shell midden and other legacy collections around the world. Preservation and research on legacy collections is vital as archaeologists increase community collaboration. Given rapid advances in aDNA, eDNA, isotope analysis, ZooMS, and other areas, research on shell midden legacy collections will only increase. That said, just like we are racing the rising tide of marine erosion, we are also raising the crisis in curation. Increased funding, space, and attention to the care and preservation of collections demands a community response and is an area in dire need of attention from people working on shell middens and other threatened archaeological sites. The need to address curation challenges is also highlighted by the growing call to gather materials from eroding/threatened sites, an effort that will place further strain on collections repositories and museums around the world. Addressing the challenges posed by the two forces of climate change/site erosion and the curation crisis is fundamental to shell midden and all archaeology. Archaeologists must work with Indigenous communities and other stakeholders to obtain funding to secure resources for curation and to collaborate on ethical shared stewardship agreements that empower communities with oversight of collections and consultation in research.

Community Collaboration

One of the most important developments of modern archaeological practice is a growing emphasis on Indigenous archaeology, community collaboration, and the coproduction of knowledge (Colwell-Chanthaphonh et al. 2010; Douglass et al. 2019; Gallivan et al. 2011; Lyons 2013; McNiven 2016; Watkins 2000). Indigenous archaeology is "an archaeology done with, for, and by Indigenous people" (Colwell-Chanthaphonh et al. 2010, p. 229). In this approach, archaeology can foster land rights and sovereignty, help transcend colonialism, empower Indigenous peoples, and more (Colwell-Chanthaphonh et al. 2010; Laluk et al. 2022; Watkins 2000). Indigenous archaeology aligns with antiracist archaeology, including community consent for research, active collaboration, engagement and outreach, breaking down barriers and silos, and expanding frameworks and understanding (d'Alpoim Guedes et al. 2021; Flewellen et al. 2021). I focus on how shell midden archaeologists, especially in the Americas, Africa, and Pacific, are working to enhance community collaboration, promote Indigenous archaeology, work in collaboration with local stakeholders, and reclaim interpretations of the past (Newsom et al. 2021).

In the Northwest Coast of North America, numerous collaborative or community-centered archaeology projects have been conducted (see Moss 2011). Butler et al.'s (2019) investigation at the Čḯxwicən village, Washington, included work at several shell middens in a project that was highly collaborative with Indigenous communities from its inception, resulting in cutting-edge research, heritage management, and collaboration with Indigenous peoples. Similar projects focused on herring fisheries in Alaska and British Columbia asserted the place of archaeology in identifying people's sovereignty and rights to gather herring eggs, drawing on Indigenous knowledge, ecological research, and archaeological data often gathered from shell midden sites (Gauvreau et al. 2017; McKechnie et al. 2014; Thornton and Moss 2021). Recent volume estimations produced for shell middens in British Columbia also are part of a multiyear collaboration between Tseshaht First Nations and archaeologists (Gustas et al. 2022). Historical ecological work on clam gardens and associated shell middens discussed earlier also exemplifies collaborative archaeological research. Clam garden projects have important social justice implications by helping Indigenous communities reassert their traditional practices and land use, engage communities in food security applications, and ultimately in the construction of new clam gardens (Augustine and Dearden 2014; Deur et al. 2015; Groesbeck et al. 2014).

Many of these efforts fit into the framework of Cultural Keystone Places (CKP)—locations with high cultural salience and links between Indigenous people, landscape management, ceremony, and ritual (Lepofsky et al. 2017). The CKP framework emphasizes the significance of place and the deep time and cultural connections people have to land and seascapes through shell middens, rock art, and many other archaeological and geologic features. This work is collaborative and Indigenous centered, aimed at empowering Indigenous peoples and transcending attempts at the erasure of Indigenous people from their homelands by settler colonial nations (Lepofsky et al. 2017). This has inspired archaeology at Point Conception, California, including documentation of dozens of shell middens and other sites to help identify this region as a CKP (Rick et al. 2022).

Other projects in California exemplify collaboration between Indigenous communities and archaeologists working at shell middens (see Tushingham et al. 2020). For instance, "eco-archaeology" is a low impact and collaborative program focused on environmental topics and research questions driven by the community, including work at shell midden sites within the Amah Mutsun tribal territories of central California and beyond (Lightfoot et al. 2021). The collaborative eco-archaeology approach also emphasizes using technologies like ground penetrating radar to foster low-impact archaeology on shell middens and help build partnerships (Nelson 2021; Sanchez et al. 2021). Gonzalez (2016) also underscored the value of low-impact archaeology in California to engage concerns from Indigenous communities, including "catch and release" archaeology—recording artifacts and ecofacts and then leaving them in the field.

Schneider (2015, 2021) reported cutting-edge research on shell mounds in northern California that integrated archaeological investigations into a collaborative framework of empowerment. Here, shell middens are places of meaning, memory making, and identity for Indigenous communities and more than just the subject of research into the past. Schneider's work highlighted the fact that shell middens were places of refuge for people during the tumultuous and destructive times of the Mission period. This work chronicled cultural persistence and the value of archaeology for detailing the traditional lifeways, subsistence, and persistence in the wake of settler colonial disruptions (Schneider 2021; Schneider et al. 2018). Schneider (2015, p. 699) argued that "[n]o longer the express domain of prehistorians, shell mounds are sites of historical significance for Indians engaging with colonial enterprises." Schneider's work is a valuable guide for archaeologists working on shell middens (and other sites) around the world to enhance connections between archaeologists and Indigenous communities.

Investigation of several 18th and 19th century shell middens on the eastern Pequot reservation in Connecticut also focused on community collaboration (Hunter et al. 2014). This work was part of long-term community archaeology, including a field school, with interests in understanding the importance of shellfish in Pequot society (Silliman and Sebastian Dring 2008). On the coast of Maine, Newsom et al. (2023) discussed a comprehensive program of Indigenous archaeology focused on shell heaps and petroglyphs that integrates Indigenous perspectives on all aspects of the research, including contemporary cultural revitalization and work on climate change, and an approach that puts archaeology in service to the community. Similarly, Gallivan et al. (2011) promoted community collaboration and decolonizing efforts in archaeology in Tidewater, Virginia, including research at shell middens (Jenkins and Gallivan 2020). Another example of collaborative archaeology with an emphasis on social justice includes a recent meta-analysis of oysters from archaeological shell middens throughout North America and part of eastern Australia (Reeder-Myers et al. 2022). While documenting long-term patterns of sustainable harvest, this work called for Indigenous descendant communities to be involved in the modern management of oysters and estuarine ecosystems in their ancestral homelands (Reeder-Myers et al. 2022). Also working in eastern North America, Birch et al. (2022) emphasized radiocarbon chronology building as a way to promote Indigenous research agendas and reassert sovereign rights to territories, including in ancestral Muscogee lands that contain extensive shell middens.

Archaeologists in Australia and Oceania have performed collaborative research for decades, including work at shell middens (Clarke 2002; Greer et al. 2002; Ulm 2006). Today, this collaborative approach pervades many coastal archaeological projects. For example, the Brown Creek Community archaeology project in Victoria included collaborative work at a Late Holocene shell midden (Lawler et al. 2014). This research and training project focused on Indigenous shell middens, including test excavations and analysis. Similar collaborative work occurs throughout the Indo-Pacific and Pacific Islands and adjacent regions (Kawelu 2015; McNiven 2013, 2016).

Using examples from the Caribbean and Madagascar, Douglass and Cooper (2020) emphasized collaboration and increased equity in historical-ecological research. In their perspective, archaeology can be more collaborative and inclusive but also is a means to underscore climate-related social inequities that occur in Madagascar, the southwest Indian Ocean, Caribbean, and other regions. Past and ongoing community collaboration and research in Madagascar includes research on shellfish harvest and remote sensing (Davis et al. 2021b; Douglass 2017; Douglass et al. 2019). Shellfishing plays a prominent role in this work, including projects with contemporary women on gathering practices and the application to the identification, sorting, and interpretation of archaeological shell (Douglass et al. 2019). Indigenous archaeology is also helping rewrite problematic narratives in the Caribbean that sought to erase Indigenous peoples (Hofman et al. 2018a, b).

Archaeologists and heritage managers around the world are also collaborating with local communities and stakeholders on the preservation, documentation, and study of archaeological sites. This is particularly true for coastal archaeology and shell middens, which are increasingly threatened by sea level rise and climate change. Drawing on examples from Scotland, Florida, and Maine, Dawson et al. (2020) suggested that citizen science can educate the public, build concern for threatened archaeological sites, and engage people in proactively working to steward archaeological resources. Programs like Maine's Midden Minders include data gathering with monthly visits and observations, annual erosion surveys, and evaluation of storm damage, all of which is preceded by participant registration and training (Dawson et al. 2020). Consultation and dialog must be ongoing with perspectives of Indigenous descendant communities prioritized, especially since some communities see erosion of sites as a natural process and may not advocate for preservation or salvage of site deposits.

Conclusion: Trends and Directions

Following two centuries of research and exploration, shell midden archaeology in the 21st century is thriving and pushing new boundaries in archaeological practice and research. In the introduction, I highlighted five global issues where shell midden archaeology has made strong contributions: (1) the importance of coastal resources in human history and cultural evolution, (2) the impact of past peoples on terrestrial and aquatic organisms and ecosystems, (3) the ways people altered their land and seascapes through daily activities, village construction, ceremony, and ritual, (4) archaeological site formation processes, and (5) how to increase collaboration with descendant communities, foster inclusion, and promote multiple ways of knowing the past. Here, I revisit these issues and point to future directions in shell midden archaeology.

During the past two decades, archaeologists have extended the antiquity of maritime foraging, hunting, and fishing deeper in time, with analyses of shell middens and other sites documenting how early anatomically modern humans, Neandertals, and other members of the genus *Homo* relied on aquatic foods and environments (Erlandson 2001; Marean 2014; Jerardino 2016; Zilhão et al. 2020). Shell middens are the physical remains of these long-term relationships between people and aquatic ecosystems that span well over 100,000 years. This deep history is being expanded by archaeological research on land and underwater, including research on the distant past through more recent colonialism and into the present-day (Astrup et al. 2021; Bailey and Hardy 2021b; Schneider 2021; Voorhies and Martínez-Tagüeña 2018).

Archaeological analyses of Holocene and earlier shell middens build the foundation for historical-ecological research and contributions to biological conservation and management in the present (see Erlandson and Rick 2010). Archaeological materials from shell middens are a cornerstone of fisheries management studies, with important conservation management implications around the world (e.g., Braje et al. 2015; Llorente-Rodríguez et al. 2022; McKechnie et al. 2014; Reeder-Myers et al. 2022). These collaborative, transdisciplinary projects illustrate archaeology's contribution to broad issues of human and environmental health and sustainability (Douglass and Cooper 2020; Wolverton et al. 2016). This work also demonstrates the connections between cultural diversity and environmental change, perspectives that challenge the notion that shell middens (and middens more generally) are merely secular refuse deposits (McNiven 2013). Research on terraforming large shell middens underscores this issue by highlighting the cultural practices responsible for significant landscape alteration in earthen and shell mound deposits and the interconnections between ritual, ceremony, daily activities, and past, present, and future environmental change (Grier and Schwadron 2017). At the same time, shell middens leave behind distinct soil conditions and promote unique biotic communities in the present, attesting to the long-term legacies of past human land use (Armstrong et al. 2021).

Crosscutting these research issues is heightened emphasis on formation processes through taphonomic and geoarchaeological research on land and underwater (Cook Hale et al. 2021; Robson et al. 2023; Szabó 2017). Research on formation processes is essential to all of archaeology and crucial to improving our interpretations of shell midden and other sites (Villagran 2019).

Shell midden archaeologists are leaders in community collaboration as we work to make archaeology more inclusive and centered on the needs, goals, and values of descendant communities (Lepofsky et al. 2017; Lightfoot et al. 2021). At the same time, we are literally "racing a rising tide" that threatens to destroy shell middens and other coastal heritage around the world (Erlandson 2008). As we work to combat the effects of sea level rise and erosion and steward collections from shell middens sites, collaboration with Indigenous communities and the public is essential for the care, stewardship, and understanding of shell middens and the diverse constituents they contain (Dawson et al. 2020).

Where is shell midden archaeology headed in the future? Methodological breakthroughs are creating new directions in shell midden archaeology, driving new research paradigms, and promoting new research questions. Recent advances in the archaeology of submerged shell middens demonstrate that even more exciting discoveries will occur in the future and further elucidate past human interactions with aquatic environments (e.g., Astrup et al. 2021). Similarly, environmental and ancient DNA, micropmorphology, remote sensing, and compound specific isotope analyses are propelling archaeological inquiry, shell midden research, and contributions to transdisciplinary research issues (Davis et al. 2020; Der Sarkissian et al. 2020; Elliott Smith et al. 2023; Misarti et al. 2017; Oertle et al. 2022).

Already inherently interdisciplinary, shell midden archaeology is becoming even more collaborative across the social and natural sciences. This is evident in the fact that dozens of archaeologists, including many shell midden specialists, are members of the recently formed Conservation Paleobiology Network, a group of paleobiologists, environmental historians, archaeologists, and paleoecologists committed to demonstrating the application of historical perspectives to contemporary environmental issues. A key prospect here is contributing to big data and archaeological synthesis projects that are occurring in biodiversity, zooarchaeology, and other areas (see Lau and Kansa 2018; LeFebvre et al. 2019). Further investment by shell midden archaeologists in big data efforts could increase our contribution to environmental, climatic, and sociopolitical issues and ensure that such approaches emphasize community consultation (Gupta et al. 2020).

Shell midden archaeologists must continue to promote, embrace, and expand collaboration, consultation, and engagement with descendant communities and put archaeology in the service of the needs and desires of those communities. To this end, it is essential that we continue to grow and diversify our community of scholars and practice. Adding new voices and perspectives to the already rich and diverse community of researchers working on shell middens will serve to broaden and expand the field of inquiry, foster better research, education, and outreach, promote shell midden archaeology's longevity and success, and contribute to social and environmental justice (Laluk et al. 2022). With a rich tradition of research, the future of shell midden archaeology is exciting and poised to make even greater contributions to our understanding of the human past and to issues of broad significance to our shared future.

Acknowledgments This paper is dedicated to Mike Glassow, Jeanne Arnold, and especially Jon Erlandson who first got me interested in shell midden archaeology in the 1990s. I thank Greg Waselkov for encouraging me to write a synthetic paper on shell middens back in 2012. I am indebted to many scholars and collaborators (too many to list here), but I am particularly grateful for collaborations and interactions with Todd Braje, Kristina Douglass, Jon Erlandson, Scott Fitzpatrick, Courtney Hofman, Madonna Moss, Leslie Reeder-Myers, Victor Thompson, René Vellanoweth, and Catherine West. I thank Peter Astrup, Paulo DeBlasis, Niklas Hausmann, Simon Holdaway, Antonieta Jerardino, Curtis Marean, and Victor

Thompson for permission to reproduce shell midden photos from their research. This manuscript was greatly improved by comments from Todd Braje on an earlier draft. Finally, I thank Gary Feinman, Linda Nicholas, Chelsey Armstrong, Michelle LeFebvre, Kent Lightfoot, Victor Thompson, and three anonymous reviewers for comments that greatly improved this manuscript. Any errors of fact are solely mine.

References Cited

Ainis, A. F. (2020). Using sea urchin remains to infer the health of kelp forest ecosystems in the past: Identification, quantification, and allometric reconstructions of harvested sea urchin (*Strongylocentrotus* spp.) on California's Channel Islands. *Journal of Island and Coastal Archaeology* **17**: 246–273.

Ainis, A. F., Porcayo-Michelini, A., Vellanoweth, R. L., and Guía-Ramírez, A. (2021). Morphometric and stable isotope analysis of archaeological *Totoaba macdonaldi* otoliths, Baja California, México. *Quaternary International* **595**: 98–117.

Allen, M. J. (ed.) (2017). *Molluscs in Archaeology*, Oxbow Books, Oxford.

Allen, M. S. (2012). Molluscan foraging efficiency and patterns of mobility amongst foraging agriculturalists: A case study from northern New Zealand. *Journal of Archaeological Science* **39**: 295–307.

Álvarez, M., Godino, I. B., Balbo, A., and Madella, M. (2011). Shell middens as archives of past environments, human dispersal and specialized resource management. *Quaternary International* **239**: 1–7.

Amano, N., Bankoff, G., Findley, D. M., Barretto-Tesoro, G., and Roberts, P. (2021). Archaeological and historical insights into the ecological impacts of pre-colonial and colonial introductions into the Philippine Archipelago. *The Holocene* **31**: 313–330.

Ambrose, W. R. (1967). Archaeology and shell middens. *Archaeology and Physical Anthropology in Oceania* **2**: 169–187.

Anderson, A. (2008). Short and sometimes sharp: Human impacts on marine resources in the archaeology and history of south Polynesia. In Rick, T. C., and Erlandson, J. M. (eds.), *Human Impacts on Ancient Marine Ecosystems: A Global Perspective*, University of California Press, Berkeley, pp. 21–42.

Anderson, A., and Smith, I. (1996). The transient village in southern New Zealand. *World Archaeology* **27**: 359–371.

Anderson, D. G., Bissett, T. G., Yerka, S. J., Wells, J. J., Kansa, E. C., Kansa, S. W., et al. (2017). Sea-level rise and archaeological site destruction: An example from the southeastern United States using DINAA (Digital Index of North American Archaeology). *PLoS ONE* **12(11)**: e0188142. https://doi.org/10.1371/journal.pone.0188142

Anderson, S. H. (2000). "Køkkenmøddinger" (shell middens) in Denmark: A survey. *Proceedings of the Prehistoric Society* **66**: 361–384.

Anderson, S. H. (2013). *Tybrind Vig: Submerged Mesolithic Settlements in Denmark, Jutland*, Archaeological Society Publications, Vol. 77, Jutland Archaeological Society, Højbjerg.

Andrus, C. F. T. (2011). Shell midden sclerochronology. *Quaternary Science Reviews* **30**: 2892–2905.

Armstrong, C. G., Dixon, W. M., and Turner, N. J. (2018). Management and traditional production of beaked hazelnut (k'áp'xw-az', *Corylus cornuta*; Betulaceae) in British Columbia. *Human Ecology* **46**: 547–559.

Armstrong, C. G., Miller, J., McAlvay, A. C., Ritchie, P. M., and Lepofsky, D. (2021). Historical Indigenous land-use explains plant functional trait diversity. *Ecology and Society* **26(2)**: 6. https://doi.org/10.5751/ES-12322-260206

Armstrong, C. G., Earnshaw, J., and McAlvay, A. C. (2022). Coupled archaeological and ecological analyses reveal ancient cultivation and land use in Nuchatlaht (Nuu-chah-nulth) territories, Pacific Northwest. *Journal of Archaeological Science* **143**: 105611.

Ash, J., Faulkner, P., Brady, L. M., and Rowe, C. (2013). Morphometric reconstructions and size variability analysis of the surf clam, *Atactodea* (=*Paphies*) *striata*, from Muralag 8, southwestern Torres Strait, northern Australia. *Australian Archaeology* **77**: 82–93.

Astrup, P. M., Skriver, C., Benjamin, J., Stankiewics, F., Ward, I., McCarthy, J. et al. (2020). Underwater shell middens: Excavation and remote sensing of a submerged Mesolithic site at Hjarnø, Denmark. *Journal of Island and Coastal Archaeology* **15**: 457–476.

Astrup, P. M., Benjamin, J., Stankiewicz, F., Woo, K., McCarthy, J., Wiseman, C., et al. (2021). A drowned Mesolithic shell midden complex at Hjarnø Vesterhoved, Denmark and its wider significance. *Quaternary Science Reviews* **258**: 106854.

Attenbrow, V. (1992). Shell bed or shell midden. *Australian Archaeology* **34**: 3–21.

Augustine, S., and Dearden, P. (2014). Changing paradigms in marine and coastal conservation: A case study of clam gardens in the southern Gulf Islands, Canada. *Canadian Geographer* **58:** 305–314. https://doi.org/10.1111/cag.12084

Bailey, G. N. (1975). The role of molluscs in coastal economies: The results of midden analysis in Australia. *Journal of Archaeological Science* **2**: 45–62.

Bailey, G. N., and Flemming, N. C. (2008). Archaeology of the continental shelf: Marine resources, submerged landscapes and underwater archaeology. *Quaternary Science Reviews* **27**: 2153–2165.

Bailey, G. N., and Hardy, K. (eds.) (2021a). *Coastal prehistory and submerged landscapes: Molluscan resources, shell-middens and underwater investigations*, *Quaternary International* **584**: 1–182.

Bailey, G. N., and Hardy, K. (2021b). Coastal prehistory and submerged landscapes: Molluscan resources, shell-middens and underwater investigations. *Quaternary International* **584**: 1–8.

Bailey, G. N., and Milner, N. (2002). Coastal hunter-gatherers and social evolution: Marginal or central? *Before Farming* **3–4**: 1–22.

Bailey, G., and Parkington, J. (1988). The archaeology of prehistoric coastlines: An Introduction. In Bailey, G., and Parkington, J. (eds.), *The Archaeology of Prehistoric Coastlines*, Cambridge University Press, Cambridge, pp. 1–10.

Bailey, G. N., Barrett, J., Craig, O., and Milner, N. (2008). Historical ecology of the North Sea Basin: An archaeological perspective and some problems of methodology. In Rick, T. C., and Erlandson, J. M. (eds.), *Human Impacts on Ancient Marine Ecosystems: A Global Perspective*, University of California Press, Berkeley, pp. 215–242.

Bailey, G. N., Hardy, K., and Camara, A. (eds.) (2013). *Shell Energy: Mollusc Shells as Coastal Resources*, Oxbow Books, Oxford.

Bailey, G. N., Devés, M. H., Inglis, R. H., Meredith-Williams, M. G., Momber, G., Sakellariou, D., et al. (2015). Blue Arabia: Paleolithic and underwater survey in SW Arabia and the role of coasts in Pleistocene dispersals. *Quaternary International* **382**: 42–57.

Bailey, G. N., Anderson, S. H., and Maarleveld, T. J. (2020). Denmark: Mesolithic coastal landscapes submerged. In Bailey, G., Galanidou, N., Peeters, H., Joens, H., and Mennenga, M. (eds.), *The Archaeology of Europe's Drowned Landscapes*, Springer, New York, pp. 39–76.

Balbo, A., Briz Gordino, I., Álvarez, M., and Madella, M. (eds.) (2011). *Shell Midden Research: An Interdisciplinary Agenda for the Quaternary and Social Sciences*, *Quaternary International* **239 (1–2)**.

Barber, I. G., and Higham, T. F. G. (2021). Archaeological science meets Māori knowledge to model pre-Columbian sweet potato (*Ipomoea batatas*) dispersal to Polynesia's southernmost habitable margins. *PLoS ONE* **16(4)**: e0247643. https://doi.org/10.1371/journal.pone.0247643

Barrett, J. H. (2019). An environmental (pre)history of European fishing: Past and future archaeological contributions to sustainable fisheries. *Fish Biology* **94**: 1033–1044.

Bas, M., Briz I Godinio, I., Álvarez, M., Vales, D. G., Crespo, E. A., and Cardona, L. (2019). Back to the future: Late Holocene marine food web structure in a warm south-western Atlantic Ocean. *Global Change Biology* **25**: 404–419.

Béarez, P., Jackson, D., and Mollaret, N. (2015). Early Archaic fishing (12,600–9,200 cal yr BP) in the semiarid north coast of Chile. *Journal of Island and Coastal Archaeology* **10**: 133–148.

Béarez, P., Feuntes-Mucherl, F., Rebolledo, S., Salazar, D., and Olguín, L. (2016). Billfish foraging along the northern coast of Chile during the Middle Holocene (7400–5900 cal BP). *Journal of Anthropological Archaeology* **41**: 185–195.
Benjamin, J., O'Leary, M., McDonald, J., Wiseman, C., McCarthy, J., Beckett, E., et al. (2020) Aboriginal artefacts on the continental shelf reveal ancient drowned cultural landscapes in northwest Australia. *PLoS ONE* **15(7)**: e0233912. https://doi.org/10.1371/journal.pone.0233912
Benjamin, J., O'Leary, M., McCarthy, J., Reynen, W., Wiseman, C., Leach, J., et al. (2023). Stone artefacts on the seabed at a submerged spring confirm a drowned cultural landscape in Murujuga, Western Australia. *Quaternary Science Reviews* **313:** 108190.
Beresford-Jones, D. G., Friesem, D. E., Sturt, F., Pullen, A., Chauca, G., Moat, J., et al. (2022). Insights into changing coastlines, environments and marine hunter-gatherer lifestyles on the Pacific Coast of South America from the La Yerba II shell midden, Río Ica Estuary, Peru. *Quaternary Science Reviews* **285**: 107509.
Betts, M., and Hrynick, G. (eds.) (2017). *Special Volume 10: North American East Coast Shell Midden Research*, *Journal of the North Atlantic* **31**.
Bicho, N., and Esteves, E. (2022). Pleistocene hunter-gatherer coastal adaptations in Atlantic Iberia. *Frontiers in Earth Science* **10**: 957214. doi: https://doi.org/10.3389/feart.2022.957214
Bicho, N., Umbelino, C., Detry, C., and Pereira, T. (2010). The emergence of Muge Mesolithic shell middens in central Portugal and the 8200 cal yr BP cold event. *Journal of Island and Coastal Archaeology* **5**: 86–104.
Birch, J., Hunt, T. W., Lesage, L., Richard, J.-F., Sioui, L. A., and Thompson, V. D. (2022). The role of radiocarbon dating in advancing Indigenous-led archaeological research agendas. *Humanities and Social Sciences Communications* **9**: 228.
Bird, D. W., and Bliege Bird, R. (2000). The ethnoarchaeology of juvenile foragers: Shellfish strategies among Meriam children. *Journal of Anthropological Archaeology* **19**: 461–476.
Biton-Porsmoguer, S., Bouchoucha, M., Marco-Miralles, F., Salazar, D., and Béarez, P. (2022). Fish vertebrae as archaeological biomarkers of past marine ecological conditions: Comparison of mercury levels in Chilean swordfish between the Middle Holocene and the modern period. *International Journal of Osteoarchaeology* **32**: 111–119.
Bjerk, H., Mjelva Breivik, H., Freitheim, S., Piana, E., Skar, B., Tivoli, A., and Zangrando, A. F. J. (eds.) (2016). *Marine Ventures: Archaeological Perspectives on Human-Sea Relations*, Equinox Publishing, Sheffield.
Boivin, N., and Fuller, D. Q. (2009). Shell middens, ships and seeds: Exploring coastal subsistence, maritime trade, and the dispersal of domesticates in and around the ancient Arabian Peninsula. *Journal of World Prehistory* **22**: 113–180.
Boulanger, C., Ingicco, T., Piper, P. J., Amano, N., Grouard, S., Ono, R., Hawkins, S., and Pawlik, A. F. (2019). Coastal subsistence strategies and mangrove swamp evolution at Bubog I Rockshelter (Ilin Island, Mindoro, Philippines) from the Late Pleistocene to the mid-Holocene. *Journal of Island and Coastal Archaeology* **14**: 584–604.
Bowers, P. M., and Moss, M. (2001). The North Point Wet Site and the subsistence importance of Pacific cod on the northern Northwest Coast. In Gerlach, S. C., and Murray, M. S. (eds.), *People and Wildlife in Northern North America: Essays in Honor of R. Dale Guthrie*, BAR International Series 944, British Archaeological Reports, Oxford, pp. 159–177.
Bowler, J. M., Price, D. M., Sherwood, J. E., and Carey, S. P. (2018). The Moyjil site, southwest Victoria, Australia: Fire and environment in a 120,000-year coastal midden—nature or people? *The Royal Society of Victoria* **130**: 71–93.
Braje, T. J., Rick, T. C., Erlandson, J. M., and DeLong, R. L. (2011). Resilience and reorganization: Archaeology and historical ecology of California Channel Island marine mammals. In Braje, T. J., and Rick, T. C. (eds.), *Human Impacts on Seals, Sea Lions, and Sea Otters: Integrating Archaeology and Ecology in the Northeast Pacific*, University of California Press, Berkeley, pp. 273–296.
Braje, T. J., Erlandson, J. M., and Rick, T. C. (2014). The formation and distribution of large shell mounds in California's Santa Barbara channel region. In Roksandic, M., Mendonça, S., Eggers, S., Burchell, M., and Klokler, D. (eds.), *The Cultural Dynamics of Shell Middens and Shell Mounds: A Worldwide Perspective*, University of New Mexico Press, Albuquerque, pp. 1–10.
Braje, T. J., Rick, T. C., Erlandson, J. M., Rogers-Bennett, L., and Catton, C. (2015). Historical ecology can inform restoration site selection: The case of black abalone (Haliotis cracherodii) along California's Channel Islands. Aquatic Conservation: Marine and Freshwater Ecosystems 26: 470–481 DOI: https://doi.org/10.1002/aqc.2561

Braje, T. J., Leppard, T., Fitzpatrick, S. M., and Erlandson, J. M. (2017a). Archaeology, historical ecology, and anthropogenic island ecosystems. *Environmental Conservation* **44**: 286–297.
Braje, T. J., Rick, T. C., Szpak, P., Newsome, S., McCain, J. M., Eliott Smith, E., Glassow, M., and Hamilton, S. (2017b). Historical ecology and the conservation of large, hermaphroditic fishes in Pacific Coast kelp forest ecosystems. *Science Advances* **3**(2): e1601759. DOI: https://doi.org/10.1126/sciadv.1601759.
Braje, T. J., Maloney, J. M., Gusick, A. E., Erlandson, J. M., Nyers, A., Davis, L., et al. (2019). Working from the known to the unknown: Linking the subaerial archaeology and the submerged landscapes of Santarosae Island, Alta California, USA. *Open Quaternary* **5(1)**: 10. DOI: https://doi.org/10.5334/oq.66
Braje, T. J., Maloney, J., Gusick, A., Erlandson, J. M., and Klotsko, S. (2022). Re-evaluating terminal Pleistocene and Early Holocene settlement patterns with Chirp subbottom data from around California's Northern Channel Islands. *World Archaeology* **54**: 107–121.
Brenner, Mareike, J., Ryano, K. P., and Wurz, S. (2022). Coastal adaptation at Klasies River main site during MIS 5c-d (93,000–110,000 years ago) from a southern Cape perspective. *Journal of Island and Coastal Archaeology* **17**: 218–245.
Broughton, J. M. (2002). Pre-Columbian human impact on California vertebrates: Evidence from old bones and implications for wilderness policy. In Kay, C. E. (ed.), *Wilderness and Political Ecology: Aboriginal Influences and the Original State of Nature*, University of Utah Press, Salt Lake City, pp. 44–71.
Broughton, J. M., Codding, B. F., Faith, J. T., Mohlenhoff, K. A., Gruhn, R., Brenner-Coltrain, J., and Hart, I. A. (2022). El Niño frequency threshold controls coastal biotic communities. *Science* **377**: 1202–1205.
Butler, V., Bovy, K. M., Campbell, S. K., Etnier, M. A., and Sterling, S. L. (2019). The Čḯxwicən project of northwest Washington state, USA: Opportunity lost, opportunity found. *Journal of Archaeological Science: Reports* **23**: 1095–1103.
Campbell, S. K. (2005). Shell middens. In Schwartz, M. L. (eds.), *Encyclopedia of Coastal Science,* Springer, Dordrecht, pp. 870–873. https://doi.org/10.1007/1-4020-3880-1_286
Cannarozzi, N. R., and Kowalewski, M. (2019). Seasonal oyster harvesting recorded in a Late Archaic period shell ring. *PLoS ONE* **14(11)**: e0224666.
Cardoso, J. L. (2015). Carlos Ribeiro and Francisco António Pereira da Costa: Dawn of Mesolithic shell middens of Muge (Salvaterra de Magos). In Bicho, N., Detry, C., Price, T. D., and Cunha, E. (eds.), *Muge 150th: The 150th Anniversary of the Discovery of Mesolithic Shellmiddens*, Vol. 1, Cambridge Scholars Publishing, Newcastle, pp. 1–18.
Ceci, L. (1984). Shell midden deposits as coastal resources. *World Archaeology* **16**: 62–74.
Chakroun, A., Chahid, D., Boudad, L., Campmas, E., Lenoble, A., Nespoulet, R., and Abdeljalil El Hajraoui, M. (2017). The Pleistocene of Rabat (Morocco): Mollusks, coastal environments and human behavior. *African Archaeological Review* **34**: 493–510.
Christensen, A. (1986). The identification and study of Indian shell middens in eastern North America: 1643–1861. *North American Archaeologist* **6**: 227–243.
Claassen, C. (1991). Normative thinking and shell bearing sites. *Advances in Archaeological Method and Theory* **3**: 249–298.
Claassen, C. (1993). Shell mounds as burial mounds: A revision of the shell mound Archaic. In Polack, D., and Henderson, G. (eds.), *Recent Research in Kentucky*, Volume 2, Kentucky Heritage Council, Frankfurt, pp. 1–12.
Claassen, C. (1999). *Shells*, Cambridge University Press, Cambridge.
Claassen, C. (2013). Freshwater shell mounds of the Ohio River valley. In Bailey, G., Hardy K., and Camara, A. (eds.), *Shell Energy: Mollusc Shells and Coastal Resources*, Oxbow Books, Oxford, pp. 35–42.
Clarke, A. (2002). The ideal and the real: Cultural and personal transformations of archaeological research on Groote Eylandt, northern Australia. *World Archaeology* **34**: 249–264.
Codding, B. F., O'Connell, J. F., and Bird, D. W. (2014). Shellfishing and the colonization of Sahul: A multivariate model evaluating the dynamic effects of prey utility, transport considerations and life-history on foraging patterns and midden composition. *Journal of Island and Coastal Archaeology* **9**: 238–252.
Colaninno, C. (2022). Foodways of the Late Archaic people of St. Catherine's Island, Georgia: An analysis of vertebrate remains from two shell rings. *Southeastern Archaeology* **41**: 183–199.

Colonese, A. C., Mannino, M. A., Bar-Yosef Mayer, D. E., Fa, D. A., Finlayson, J. C., Lubell, D., and Stiner, M. C. (2011). Marine mollusc exploitation in Mediterranean prehistory: An overview. *Quaternary International* **239**: 86–103.

Colonese, A. C., Lo Vetro, D., and Martini, F. (2014). Holocene coastal change and intertidal mollus exploitation in the central Mediterranean: Variations in shell size and morphology at Grotta d'Oriente (Siciliy). *Archaeofauna* **23**: 181–192.

Colten, R. H. (2015). Prehistoric coastal adaptations at Seaside, Oregon: Vertebrate fauna from the Palmrose and Par-Tee sites. *Journal of Island and Coastal Archaeology* **10**: 253–276.

Colwell-Chanthaphonh, C., Ferguson, T. J., Lippert, D., McGuire, R. H., Nicholas, G. P., Watkins, J. E., and Zimmerman, L. J. (2010). The premise and promise of Indigenous archaeology. *American Antiquity* **75**: 228–238.

Cook Hale, J. W., Hale, N. L., and Garrison, E. G. (2019). What is past is prologue: Excavations at the Florida Econfina Channel site, Apalachee Bay, Florida, USA. *Southeastern Archaeology* **1**: 1–22.

Cook Hale, J., Benjamin, J., Woo, K., Astrup, P. M., McCarthy, J., Hale, N., et al. (2021). Submerged landscapes, marine transgression, and underwater shell middens: Comparative analysis of site formation and taphonomy in Europe and North America. *Quaternary Science Reviews* **258**: 106867.

Cook Hale, J. W., Hale, N. L., Newton, M., and Garrison, E. G. (2022). The tempest: Geoarchaeological examinations of tropical cycle/hurricane signatures in a submerged, formerly coastal shell midden site, Econfina Channel, Florida, USA. *Journal of Archaeological Science* **144**: 105636.

Cook Hale, J. W., Davis, D. S., and Sanger, M. C. (2023). Evaluating the archaeological efficacy of bathymetric LiDAR across oceanographic contexts: A case study from Apalachee Bay, Florida. *Heritage* **6(2)**: 928–945. https://doi.org/10.3390/heritage6020051

Cook-Patton, S. C., Weller, D., Rick, T. C., and Parker, J. D. (2014). Ancient experiments: Forest biodiversity enhanced by Native American middens. *Landscape Ecology* **29**: 979–987.

Cooper, Z. (1997). The salient features of site location in the Andaman Islands, Indian Ocean. *Asian Perspectives* **36:** 220–231.

Cortés-Sánchez, M., Morales-Muñiz, A., Simón-Vallejo, M. D., Lozano-Francisco, M. C., Vera-Peláez, J. L., Finlayson, C., et al. (2011). Earliest known use of marine resources by Neanderthals. *PLoS ONE* **6(9)**: e24026. https://doi.org/10.1371/journal.pone.0024026

Cox, K. D., Davies, H. L., Davidson, K. H., Gerwing, T. G., Dudas, S. E., and Juanes, F. (2020). Shellfish subsidies along the Pacific Coast of North America. *Ecography* **43**: 668–681.

Crowther, A., Lucas, L., Helm, R., Horton, M., Shipton, C., Wright, H. T., et al. (2016) Ancient crops provide first archaeological signature of the westward Austronesian expansion. *Proceedings of the National Academy of Sciences USA* **113**: 6635–6640.

Crumley, C. L. (2021). Historical ecology: A robust bridge between archaeology and ecology. *Sustainability* **13**: 8210.

d'Alpoim Guedes, J., Gonzalez, S., and Rivera-Collazo, I. (2021). Resistance and care in the time of COVID-19: Archaeology in 2020. *American Anthropologist* **123**: 898–915.

Dall, W. (1877). On succession in the shell-heaps of the Aleutian Islands. *United States Geological and Geographic Survey, Contributions to North American Ethnology* **1**: 41–91.

Davis, D., DiNapoli, R., Sanger, M., and Lipo, C. (2020). The integration of Lidar and legacy datasets provides improved explanations for the spatial patterning of shell rings in the American Southeast. *Advances in Archaeological Practice* **8(4):** 361–375.

Davis, D. S., Seeber, K. E., and Sanger, M. C. (2021a). Addressing the problem of disappearing cultural landscapes in archaeological research using multi-scalar survey. *Journal of Island and Coastal Archaeology* **16**: 524–540.

Davis, D. S., Buffa, D., Rasolondrainy, T., Creswell, E., Anyanwu, C., Ibirogba, A., et al. (2021b). The aerial panopticon and the ethics of archaeological remote sensing in sacred cultural spaces. *Archaeological Prospection* **28**: 305–320.

Dawson, T., Hambly, J., Kelley, A., Lees, W., and Miller, S. (2020). Coastal heritage, global climate change, public engagement, and citizen science. *Proceedings of the National Academy of Sciences USA* **117**: 8280–8286.

de Nascimento, L., Nogué, S., Naranjo-Cigala, A., Criado, C., McGlone, M., Fernández-Palacios, E., and Fernández-Palacios, J. M. (2020). Human impact and ecological changes during prehistoric settlement on the Canary Islands. *Quaternary Science Reviews* **239**: 106332.

DeBlasis, P., Gaspar, M., and Kneip, A. (2021). Sambaquis from the southern Brazilian coast: Landscape building and enduring heterarchical societies throughout the Holocene. *Land* **10**: 757. https://doi.org/10.3390/land10070757

Der Sarkissian, C., Möller, P., Hofman, C., Ilsøe, P., Rick, T., Schiøtte, T., et al. (2020). Unveiling the ecological applications of ancient DNA from mollusk shells. *Frontiers in Ecology and Environment* **8**: 37. doi: https://doi.org/10.3389/fevo.2020.00037

Des Lauriers, M. R. (2010). *Island of Fogs: Archaeological and Ethnohistorical Investigations of Isla Cedros, Baja California*, University of Utah Press, Salt Lake City.

Deur, D., Dick, A., Recalma-Clutesi, K., and Turner, N. J. (2015). Kwakwaka'wakw "clam gardens." *Human Ecology* **43**: 201–212.

Dillehay, T. D., Goodbred, S., Pino, M., Vásquez Sánchez, V. F., Rosales Tham, T., Adovasio, J., et al. (2017). Simple technologies and diverse food strategies of the Late Pleistocene and Early Holocene at Huaca Prieta, coastal Peru. *Science Advances* **3(5):** e1602778.

Ditchfield, K., Ulm, S., Manne, T., Farr, H., O'Grady, D., and Veth, P. (2022). Framing Australia Pleistocene coastal occupation and archaeology. *Quaternary Science Reviews* **293:** 107706.

Douglass, K. (2017). The diversity of Late Holocene shellfish exploitation in Velondriake, southwest Madagascar. *Journal of Island and Coastal Archaeology* **12**: 333–359.

Douglass, K., and Cooper, J. (2020). Archaeology, environmental justice, and climate change on islands of the Caribbean and southwestern Indian Ocean. *Proceedings of National Academy of Sciences USA* **117**: 8254–8262.

Douglass, K., Morales, E. Q., Manahira, G., Fenomanana, F., Samba, R., Lahiniriko, F., et al. (2019). Toward a just and inclusive environmental archaeology of southwest Madagascar. *Journal of Social Archaeology* **19**: 307–332.

Dunn, M. (1983). Coquile flora: An ethnobotanical reconstruction. *Economic Botany* **37**: 349–359.

Dunne, J. A., Maschner, H., Betts, M. W., Huntly, N., Russell, R., Williams, R. J., and Wood, S. A. (2016). The roles and impacts of hunter-gatherers in North Pacific marine food webs. *Scientific Reports* **6**: 21179. https://doi.org/10.1038/srep21179

Dupont, C., and Marchand, G. (2021). New paradigms in the exploitation of Mesolithic shell middens in Atlantic France: The example of Beg-er-Vil, Brittany. *Quaternary International* **584**: 59–71.

Easton, N. A., Moore, C., and Mason, A. R. (2021). The archaeology of submerged prehistoric sites on the North Pacific Coast of North America. *Journal of Island and Coastal Archaeology* **16**: 118–149.

Elliott Smith, E., Tinker, M. T., Whistler, E. L., Kennett, D. J., Vellanoweth, R. L., Gifford-Gonzalez, D., Hylkema, M. G., and Newsome, S. D. (2020). Reductions in dietary niche of southern sea otters (*Enhydra lutris nereis*). *Ecology and Evolution* **10**: 3318–3329.

Elliott Smith, E. A., Rick, T. C., and Hofman, C. A. (2022). Investigating fishing strategies and habitat differences in Late Holocene Oregon Coast sturgeon (*Acipenser* spp.) through coupled genetic and isotope analysis. *Quaternary Science Advances* **7**: 100062.

Elliott Smith, E., Braje, T., Gobalet, K., Newsome, S., Campbell, B., and Rick, T. (2023). Archaeological and stable isotope data reveal a pattern of fishing across the food web on California's Channel Islands. *The Holocene* **33:** 446–458.

Erlandson, J. M. (2001). The archaeology of aquatic adaptations: Paradigms for a new millennium. *Journal of Archaeological Research* **9**: 287–350.

Erlandson, J. M. (2008). Racing a rising tide: Global warming, rising seas, and the erosion of human history. *Journal of Island and Coastal Archaeology* **3**: 167–169.

Erlandson, J. M. (2013). Shell middens and other anthropogenic soils as global stratigraphic signatures of the Anthropocene. *Anthropocene* **4**: 24–32.

Erlandson, J. M., and Fitzpatrick, S. M. (2006). Oceans, islands, and coasts: Current perspectives on the role of the sea in prehistory. *Journal of Island and Coastal Archaeology* **1**: 5–32.

Erlandson, J. M., and Rick, T. C. (2010). Archaeology meets marine ecology: The antiquity of maritime cultures and human impacts on marine fisheries and ecosystems. *Annual Review of Marine Science* **2**: 231–251.

Erlandson, J. M., Graham, M. H., Bourque, B. J., Corbett, D., Estes, J. A., and Steneck R. S. (2007). The Kelp Highway Hypothesis: Marine ecology, the coastal migration theory and the peopling on the Americas. *Journal of Island and Coastal Archaeology* **2**: 161–174.

Erlandson, J. M., Rick, T. C., Braje, T. J., Steinberg, A., and Vellanoweth, R. L. (2008). Human impacts on ancient shellfish: A 10,000 year record from San Miguel Island, California. *Journal of Archaeological Science* **35**: 2144–2152.

Erlandson, J. M., Rick, T. C, Braje, T. J., Casperson, M., Culleton, B., Fulfrost, B., et al. (2011). Paleoindian seafaring, maritime technologies, and coastal foraging on California's Channel Islands. *Science* **331**: 1181–1185.

Erlandson, J. M., Braje, T., DeLong, R., and Rick, T. C. (2015). Natural or anthropogenic? Historical ecology and Pacific Coast pinnipeds. In Kittinger, J., McClenachan, L., Gedan, K., and Blight, L. (eds.*), Applying Marine Historical Ecology to Conservation and Management*, University of California Press, Berkeley, pp. 39–62.

Fa, D. A., Finlayson, J. C., Finlayson, G., Giles-Pacheco, F., Rodríguez-Vidal, J., and Gutiérrez-Lopez. J. M. (2016). Marine mollusc exploitation as evidenced by the Gorham's Cave (Gibraltar) excavations 1998–2005: The Middle-Upper Palaeolithic transition. *Quaternary International* **407(B)**: 16–28.

Faught, M. K., and Gusick, A. E. (2011). Submerged prehistory in the Americas. In Benjamin, J., Bonsall, C., Pickard, C., and Fischer, A. (eds.), *Submerged Prehistory*, Oxbow Books, Oxford, pp. 145–157.

Faught, M. K., and Smith, M. F. (2021). The magnificent seven: Marine submerged precontact sites found by systematic geoarchaeology in the Americas. *Journal of Island and Coastal Archaeology* **16**: 86–102.

Faulkner, P. (2014). Late Holocene coastal economies and the *Anadara granosa*-dominated shell mounds of northern Australia. In Roksandic, M., Mendonça de Souza, S., Eggers, S., Burchell, M., and Klokler, D. (eds.), *The Cultural Dynamics of Shell Matrix Sites*. University of New Mexico Press, Albuquerque, pp. 57–73.

Faulkner, P., Harris, M., Haji, O., Crowther, A., Horton, M. C., and Boivin, N. L. (2019). Towards a historical ecology of intertidal foraging in the Mafia Archipelago: Archaeomalacology and implications for marine resource management. *Journal of Ethnobiology* **39**: 182–203.

Faulkner, P., Thangavelu, A., Ferguson, R., Aird, S. J., David, B., Drury, T., et al. (2020). Middle to Late Holocene near-shore foraging strategies at Caution Bay, Papua New Guinea. *Journal of Archaeological Science: Reports* **34**: 102629.

Faulkner P., Miller, J. M., Quintana Morales, E. M., Crowther, A., Shipton, C., Ndiema, E., Boivin, N., and Petraglia, M. D. (2021). 67,000 years of coastal engagement at Panga ya Saidi, eastern Africa. *PLoS ONE* **16(8)**: e0256761. https://doi.org/10.1371/journal.pone.0256761

Faulkner P., Sarathi, A., Crowther, A., Smith, T., Harris, M., Ali, A. K., et al. (2022). Human-ecodynamics and the intertidal zones of the Zanzibar Archipelago. *Frontiers in Earth Science* **10**: 982694. doi: https://doi.org/10.3389/feart.2022.982694

Feathers, V., and McKillop, H. (2018). Assessment of the shell midden at the Eleanor Betty Salt Work, Belize. *Research Reports in Belizean Archaeology* **15**: 275–285.

Fedje, D. W., Wigen, R. J., Mackie, Q., Lake, C. R., and Sumpter, I. D. (2001). Preliminary results from investigations at Kilgii Gwaay: An early Holocene archaeological site on Ellen Island, Haida Gwaii, British Columbia. *Canadian Journal of Archaeology* **25**: 98–120

Fernández-López de Pablo, J. (2016). The timing of postglacial coastal adaptations in eastern Iberia: A Bayesian chronological model for the El Collado shell midden (Olivia, Valencia, Spain). *Quaternary International* **407**: 94–105.

Figuti, L., and Plens, C. (2014). The riverine sambaqui: Zooarchaeological study of inland Brazilian shell mounds. In Roksandic, M., Mendonça de Souza, S., Eggers, S., Burchell, M., and Klokler, D. (eds.), *The Cultural Dynamics of Shell Matrix Sites*, University of New Mexico Press, Albuquerque, pp. 213–222.

Figuti, L., Plens, C., and DeBlasis, P. (2013). Small Sambaquis and big chronologies: Shellmound building and hunter-gatherers in neotropical highlands. *Radiocarbon* **55:** 1215–1221.

Fischer, A., Gotfredsen, A. B., Meadows, J., Pederson, L., and Stafford, M. (2021). The Rødhals kitchen midden—marine adaptations at the end of the Mesolithic world. *Journal of Archaeological Science: Reports* **39**: 103102.

Fish, P. R., Fish, S. K., DeBlasis, P., and Gaspar, M. D. (2013). Monumental shell mounds as persistent places in southern coastal Brazil. In Thompson, V. D., and Waggoner, J. C., Jr. (eds.), *The Archaeology and Historical Ecology of Small Scale Economies*, University Press of Florida, Gainesville, pp. 120–140.

Fisher, J. A., Schakelford, N., Hocking, M. D., Trant, A. J., and Starzomski, B. M. (2019). Indigenous peoples' habitation drives present-day forest biodiversity in British Columbia's coastal temperate rainforest. *People and Nature* **1**: 103–114.

Fitzhugh, B., Gjesfjeld, E. W., Brown, W. A., Hudson, M. J., and Shaw, J. D. (2016). Resilience and the population history of the Kuril Islands, northwest Pacific: A study in complex human ecodynamics. *Quaternary International* **419**: 165–193.

Fitzhugh, B., Brown, W. A., Misarti, N., Takase, K., and Tremayne, A. H. (2022). Human paleodemography and paleoecology of the North Pacific Rim from the mid to late Holocene. *Quaternary Research* **108**: 123–149.

Fitzpatrick, S. M., and Braje, T. J. (2019). Island and coastal archaeology as salvage archaeology. *Journal of Island and Coastal Archaeology* **15**: 1–2.

Fitzpatrick, S. M., and Giovas, C. M. (2021). Tropical islands of the Anthropocene: Deep histories of anthropogenic terrestrial-marine entanglement in the Pacific and Caribbean. *Proceedings of the National Academy of Sciences USA* **118:** e2022209118.

Fitzpatrick, S. M., Rick, T. C., and Erlandson, J. M. (2016). Recent progress, trends, and developments in island and coastal archaeology. *Journal of Island and Coastal Archaeology* **10**: 3–27.

Flemming, N. C. (2021). Global experience in locating submerged prehistoric sites and their relevance to research on the American continental shelves. *Journal of Island and Coastal Arcaheology* **16**: 170–193.

Flewellen, A. O. Dunnavant, J. P., Odewale, A., Jones, A., Wolde-Michael, T., Crossland, Z., and Franklin, M. (2021). "The future of archaeology is antiracist": Archaeology in the time of Black Lives Matter. *American Antiquity* **86:** 224–243.

Fossile, T., Ferreira, J., da Rocha Bandeira, D., Dias-da-Silva, S., and Colonese, A. C. (2020). Integrating zooarchaeology in the conservation of coastal-marine ecosystems in Brazil. *Quaternary International* **545**: 38–44.

Fossile, T., Herbst, D. F., McGrath, K., Toso, A., Giannini, P. C. F., Milheira, R. G., et al. (2023). Bridging archaeology and marine conservation in the Neotropics. *PLoS One* 18(5): e0285951. https://doi.org/10.1371/journal.pone.0285951.

Fujita, M., Yamasaki, S., Katagiri, C., Oshiro, I., Sano, K., Kurozumi, T., et al. (2016). Advanced maritime adaptation in the western Pacific coastal region extends back to 35,000–30,000 years before present. *Proceedings of the National Academy of Sciences* USA **113**: 11184–11189.

Funk, C. (2018). Ethno-ornithology in the Rat Islands: Prehistoric Aleut relationships with birds in the western Aleutians, Alaska. *Journal of Anthropological Archaeology* **51**: 144–158.

Gallivan, M., Moretti-Langholtz, D., and Woodard, B. (2011). Collaborative archaeology and strategic essentialism: Native empowerment in Tidewater Virginia. *Historical Archaeology* **45**: 10–23.

Gamble, L. H. (2017). Feasting, ritual practices, social memory, and persistent places: New interpretations of shell mounds in southern California. *American Antiquity* **82**: 427–451.

Garvey, J. (2017). Australian aboriginal freshwater shell middens from late Quaternary northwest Victoria: Prey choice, economic variability and exploitation. *Quaternary International* **427**: 85–102.

Gauvreau, A., Lepofsky, D., Rutherford, M., and Reid, M. (2017). "Everything revolves around the herring": The Heiltsuk–herring relationship through time. *Ecology and Society* **22(2)**: 10. https://doi.org/10.5751/ES-09201-220210

Gill, K. M., Erlandson, J. M., Niessen, K., Hoppa, K., and Merrick, D. (2019). Where carbohydrates were key: Reassessing the marginality of terrestrial plant resources on California's islands. In Gill, K. M., Fauvelle, M., and Erlandson, J. (eds.), *An Archaeology of Abundance: Re-evaluating the Marginality of California's Islands*, University Press of Florida, Gainesville, pp. 98–134.

Gillis, J. R. (2012). *The Human Shore: Seacoasts in History*, University of Chicago Press, Chicago.

Giovas, C. M. (2019). The beasts at large—perennial questions and new paradigms for Caribbean translocation research, Part 1: Ethnozoogeography of mammals. *Environmental Archaeology* **24**: 182–198.

Giovas, C. M. (2021). Sustainable Indigenous fishing in the pre-contact Caribbean: Evidence and critical considerations from Carriacou, Grenada. *Sustainability* **13**: 9152.

Giovas, C. M., Fitzpatrick, S. M., Clark, M., and Abed, M. (2010). Evidence for size increase in an exploited mollusc: Humped conch (*Strombus gibberulus*) at Chelechol ra Orrak, Palau from ca. 3000–0 BP. *Journal of Archaeological Science* **37**: 2788–2798.

Gjesfjeld, E., Etnier, M. A., Takase, K., Brown, W. A., and Fitzhugh, B. (2019). Biogeography and adaptation in the Kuril Islands, Northeast Asia. *World Archaeology* **51**: 429–453.

Glassow, M. A. (2015). Chronology of red abalone middens on Santa Cruz Island, California, and evidence for subsistence and settlement change. *American Antiquity* **80**: 745–759.

Gonzalez, S. L. (2016). Indigenous values and methods in archaeological practice: Low-impact archaeology through the Kashaya Pomo interpretive trail project. *American Antiquity* **81**: 533–549.

Greenwood, R. S. (1961). Quantitative analysis of shells from a site in Goleta, California. *American Antiquity* **26**: 416–420.

Greer, S., Harrison, R., and McIntyre-Tamwoy, S. (2002). Community-based archaeology in Australia. *World Archaeology* **34**: 265–287.
Grier, C., and Schwadron, M. (2017). Terraforming and monumentality in hunter-gatherer fisher societies. *Hunter Gatherer Research* **3**: 3–8.
Grier, C., Angelbeck, B., and McLay, E. (2017). Terraforming and monumentality as long-term social practice in the Salish Sea region of the Northwest Coast of North America. *Hunter Gatherer Research* **3**: 107–132.
Grindle, E. D., Rick, T. C., Dagtas, N. D., Austin, R. M., Wellman, H. P., Gobalet, K., and Hofman, C. A. (2021). Green or white? Morphology, ancient DNA, and the identification of archaeological North American Pacific Coast sturgeon. *Journal of Archaeological Science: Reports* **36**: 102887.
Groesbeck, A. S., Rowell, K., Lepofsky, D., and Salomon, A. K. (2014). Ancient clam gardens increased shellfish production: Adaptive strategies from the past can inform food security today. *PLoS ONE* **9(3)**: e91235. https://doi.org/10.1371/journal.pone.0091235
Grono, E., Friesem, D. E., Lam, T., Nguyen, T. T., Hamilton, R., Bellwood, P., Piper, P. J., and Denham, T. (2022). Microstratigraphy reveals cycles of occupation and abandonment at the mid Holocene coastal site of Thach Lac, northern-central Vietnam. *Archaeological Research in Asia* **31**: 100396.
Gupta, N., Blair, S., and Nicholas, R. (2020). What we see, what we don't see: Data governance, archaeological spatial databases and the rights of Indigenous peoples in an age of big data. *Journal of Field Archaeology* **45**: S39–S50.
Gusick, A. E., and Davis, L. (2010). Exploring Baja California's submerged landscapes. *Journal of California and Great Basin Anthropology* **30**: 35–49.
Gusick, A. E., and Faught, M. K. (2011). Prehistoric archaeology underwater: A nascent subdiscipline critical to understanding early coastal occupations and migration routes. In Bicho, N., Haws, J., and Davis, L. (eds.), *Trekking the Shore: Changing Coastlines and the Antiquity of Coastal Settlement*, Springer, New York, pp. 27–50.
Gusick, A. E., Maloney, J., Braje, T., Retallack, G. J., Johnson, L., Klotsko, S., Ainis, A., and Erlandson, J. (2022). Soils and terrestrial sediments on the seafloor: Refining archaeological paleoshoreline estimates and paleoenvironmental reconstruction of the California coast. *Frontiers in Earth Science* **10**: https://doi.org/10.3389/feart.2022.941911
Gustas, R. H., McKechnie, I., Mackie, Q., and Darimont, C. (2022). Estimating volumes of coastal shell midden sites using geometric solids: An example from Tseshaht Territory, western Vancouver Island, British Columbia, Canada. *Advances in Archaeological Practice* **10**: 200–214.
Gutiérrez-Zugasti, I. (2011). Coastal resource intensification across the Pleistocene-Holocene transition in northern Spain: Evidence from shell size and age distributions of marine gastropods. *Quaternary International* **244**: 54–66.
Gutiérrez-Zugasti, I., Cuenca Solana, D., Colonese, A. C., and Fernández-López de Pablo, J. (eds.) (2016). *Time for the Tide: New Perspectives on Hunter-fisher-gatherer Exploitation on Intertidal Resources in Atlantic Europe and Mediterranean Regions*, *Quaternary International* **407(B)**: 1–154.
Habu, J. (2004). *Ancient Jomon of Japan*, Cambridge University Press, Cambridge.
Habu, J., and Hall, M. E. (2013). Climate change, human impacts on the landscape, and subsistence specialization: Historical ecology and changes in Jomon hunter-gatherer lifeways. In Thompson, V. D., and Waggoner, J. C., Jr. (eds.), *The Archaeology and Historical Ecology of Small Scale Economies*, University Press of Florida, Gainesville, pp. 65–78.
Habu, J., Matsui, A., Yamamoto, N., and Kanno, T. (2011). Shell midden archaeology in Japan: Aquatic food acquisition and long-term change in Jomon culture. *Quaternary International* **239**: 19–27.
Hadden, C., Hutchinson, I., and Martindale, A. (2023). Dating marine shell: A guide for the wary North American archaeologist. *American Antiquity* **88:** 62–78.
Hadden, C. S., Waselkov, G. A., Reitz, E. J., and Andrus, C. F. T. (2022). Temporality of fishery taskscapes on the north-central Gulf of Mexico coast (USA) during the Middle/Late Woodland period (AD 325–1040). *Journal of Anthropological Archaeology* **67**: 101436.
Hardy, K., Camara, A., Piqué, R., Dioh, E., Guèye, M., Diadhiou, H. D., Faye, M., and Carré, M. (2016). Shellfishing and shell midden construction in the Saloum Delta, Senegal. *Journal of Anthropological Archaeology* **41**: 19–32.
Harvey, V. L., LeFebvre, M., deFrance, S. D., Toftgaard, C., Drosou, K., Kitchener, A. C., and Buckley, M. (2019). Preserved collagen reveals species identity in archaeological marine turtle bones from Caribbean and Florida sites. *Royal Society Open Science* **6**: 31824722. https://doi.org/10.1098/rsos.191137

Hausmann, N., Meredith-Williams, M., Douka, K., Inglis, R. H., and Bailey, G. (2019). Quantifying spatial variability in shell midden formation in the Farasan Islands, Saudi Arabia. *PLoS ONE* **14(6)**: e0217596. https://doi.org/10.1371/journal.pone.0217596

Hausmann, N., Meredith-Williams, M., and Laurie, E. (2021). Shellfish resilience to prehistoric human consumption in the southern Red Sea: Variability in *Conomurex fasciatus* across time and space. *Quaternary International* **584**: 20–32.

Hausmann, N., Robson, H., and Bailey, G. (2022). Marine abundance and its prehistoric past in the Baltic. *Nature Communications* **13**: 2825. https://doi.org/10.1038/s41467-022-30150-9

Hesterberg, S., Herbert, G. S., Pluckhahn, T. J., Harke, R., Al-Qattan, N. M., Duke, C. T., et al. (2020). Prehistoric baseline reveals substantial decline of oyster reef condition in a Gulf of Mexico conservation priority area. *Biology Letters* **16**: 20190865.

Hofman, C., Hung, J., Malatesta, E., Jean, J., Sonnemann, T., and Hoogland, M. (2018). Indigenous Caribbean perspectives: Archaeologies and legacies of the first colonised region in the New World. *Antiquity* **92**: 200–216.

Hofman, C. A., Rick, T. C., Maldonado, J. E., Collins, P. W., Erlandson, J. M., Fleischer, R., et al. (2016). Tracking the diet of an island carnivore (*Urocyon littoralis*) across 7300 years of human cultural and environmental change. *Quaternary Science Reviews* **146**: 147–160.

Holdaway, S. J., Fanning, P. C., Petchey, F., Allely, K., Shiner, J. I., and Bailey, G. (2017). Temporal variability in shell mound formation at Albatross Bay, northern Australia. *PLoS ONE* **12(8)**: e0183863. https://doi.org/10.1371/journal.pone.0183863

Holl, A. F. C. (2022). The Oudierin Drainage Archaeological Project: New perspectives on the Saloum Delta shell middens (Senegal). *African Archaeological Review* **39**: 189–219.

Holland-Lulewicz, I., and Thompson, V. D. (2021). Calusa socioecological histories and zooarchaeological indicators of environmental change during the Little Ice Age in southwestern Florida, USA. *Journal of Island and Coastal Archaeology*. https://doi.org/10.1080/15564894.2021.1989638

Holmes, K., Lepofsky, D., Smith, N. F., Crowell, T. D., and Salomon, A. K. (2022). Ancestral sea gardens supported human settlements for at least 3,800 years on the Northwest Coast of North America. *Frontiers in Earth Science* **10**: 988111. doi: https://doi.org/10.3389/feart.2022.988111

Holmes, W. H. (1907). Aboriginal shell-heaps of the Middle Atlantic tidal region. *American Anthropologist* **9**: 113–128.

Horrocks, M., Brown, A., Brown, J., and Presswell, B. (2023). A plant parasite record of a midden on Auckland Isthmus, New Zealand, reveals large scale landscape disturbance, Maori-introduced cultigens, and Helminthiasis. *Asian Perspectives* **62:** 97–119.

Hrdlicka A. (1937). Man and plants in Alaska. *Science* **86**: 559–560.

Hudson, M. J. (2022). Globalization and the evolution of Japanese fisheries. In Cassidy, J., Ponkratova, I., and Fitzhugh, B. (eds.), *Maritime Prehistory of Northeast Asia*, Springer, Singapore, pp. 97–122.

Hudson, M., Uchiyama, J., Lindström, K., Kawashima, T., Reader, I., Delakorda Kawashima, T., et al. (2022). Global processes of anthropogenesis characterise the early Anthropocene in the Japanese Islands. *Humanities and Social Science Communications* **9**: 84. https://doi.org/10.1057/s41599-022-01094-8

Hunter, R., Silliman, S. W., and Landon, D. B. (2014). Shellfish collection and community connections in eighteenth-century Native New England. *American Antiquity* **79**: 712–729.

Iba, I. (2005). The Awazu Site, a shell-midden on the bottom of Lake Biwa, Japan. *Journal of Wetland Archaeology* **5**: 35–48.

Jazwa, C. J., and Mather, R. (2014). Archaeological site or natural marine community: Excavation of a submerged shell mound in Ninigret Pond, Rhode Island. *Journal of Island and Coastal Archaeology* **9**: 268–288.

Jefferies, R. W. (2008). *Holocene Hunter-Gatherers of the Lower Ohio River Valley*, University of Alabama Press, Tuscaloosa.

Jenkins, J. A. (2017). Methods for inferring oyster mariculture on Florida's Gulf Coast. *Journal of Archaeological Science* **80**: 74–82.

Jenkins, J. A., and Gallivan, N. D. (2020). Shell on earth: Oyster harvesting, consumption, and deposition practices in the Powhatan Chesapeake. *Journal of Island and Coastal Archaeology* **15**: 384–406.

Jerardino, A. (2010). Large shell middens in Lamberts Bay, South Africa: A case study of hunter-gatherer resource intensification. *Journal of Archaeological Science* **37**: 2291–2302.

Jerardino, A. (2012). Large shell middens and hunter-gatherer resource intensification along the west coast of South Africa: The Elands Bay case study. *Journal of Island and Coastal Archaeology* **7**: 76–101.
Jerardino, A. (2016). On the origins and significance of Pleistocene coastal resource use in southern Africa with particular reference to shellfish gathering. *Journal of Anthropological Archaeology* **41**: 213e230.
Jerardino, A., and Navarro, R. (2018a). Large-scale hunter-gatherer exploitation of marine resources in South Africa, Part I: 'Kreefbaii C' megamiddenm Lamberts Bay area. *South African Archaeological Bulletin* **73**: 93–107.
Jerardino, A., and Navarro, R. (2018b). Large-scale hunter-gatherer exploitation of marine resources in South Africa, Part II: Grootrif and Malkoppan megamiddenm Lamberts Bay area. *South African Archaeological Bulletin* **73**: 108–125.
Jerardino, A., Branch, G. M., and Navarro, R. (2008). Human impact on precolonial west coast marine environments of South Africa. In Rick, T. C., and Erlandson, J. M. (eds.), *Human Impacts on Ancient Marine Ecosystems*, University of California Press, Berkeley, pp. 279–296.
Jones, T. L., Porcasi, J. F., Gaeta, J., and Codding, B. F. (2008). Diablo Canyon fauna: A coarse-grained record of trans-Holocene foraging from the central California mainland coast. *American Antiquity* **73**: 289–316.
Jones, T. L., Coltrain, J. B., Jacobs, D. K., Porcasi, J., Brewer, S. C., Buckner, J. C., Perrine, J. D., and Codding, B. F. (2021). Causes and consequences of the Late Holocene extinction of the marine flightless duck (*Chendytes lawi*) in the northeastern Pacific. *Quaternary Science Reviews* **260**: 106914.
Karalius, T., and Alpert, P. (2010). High abundance of introduced plants on Native American middens. *Biological Invasions* **12**: 1125–1132.
Kawelu, K. L. (2015). *Kuleana and Commitment: Working toward a Collaborative Hawaiian Archaeology*, University of Hawaii Press, Manoa.
Kealy, S., O'Connor, S., Mahirta, Mustika Sari, D., Shipton, C., Langley, M. C., et al. (2020). Forty-thousand years of maritime subsistence near a changing shoreline on Alor Island (Indonesia). *Quaternary Science Reviews* **249:** 106599.
Kersel, M. M. (2015). Storage wars: Solving the archaeological curation crisis? *Journal of Eastern Mediterranean Archaeology and Heritage Studies* **3**: 42–54.
Kim, J., and Seong, C. (2022). Maritime prehistory of Korea: An archaeological review. In Cassidy, J., Ponkratova, I., and Fitzhugh, B. (eds.), *Maritime Prehistory of Northeast Asia*, Springer, Singapore, pp. 29–50.
Kirch, P. V. (1982). The ecology of marine exploitation in prehistoric Hawaii. *Human Ecology* **10**: 455–476.
Klein, R. G., and Bird, D. W. (2016). Shellfishing and human evolution. *Journal of Anthropological Archaeology* **44**: 198–205.
Klokler, D. (2017). Shelly coast: Constructed seascapes in southern Brazil. *Hunter Gatherer Research* **3**: 87–105.
Koloseike, A. (1970). Costs of shell analysis. *American Antiquity* **35**: 475–479.
Komatsu, A., Cooper, E. J., Alsos, I. G., and Brown, A. G. (2022). Towards a Jōmon food database: Construction, analysis, and implications for Hokkaido and the Ryuku Islands, Japan. *World Archaeology*. https://doi.org/10.1080/00438243.2022.2089726
Krus, A., and Thompson, V. D. (2019). The complexities of dating island and coastal settlements. *Journal of Island and Coastal Archaeology* **14**: 1–4.
Kwak, S., Obata, H., and Lee, G.-A. (2022). Broad-spectrum foodways in southern coastal Korea in the Holocene: Isotopic and archaeobotanical signatures in Neolithic shell middens. *Journal of Island and Coastal Archaeology* **17**: 97–125.
Kwiecien, O., Braun, T., Brunello, C. F., Faulkner, P., Hausmann, N., Helle, G., et al. (2022). What we talk about when we talk about seasonality—A transdisciplinary review. *Earth-Science Reviews* **225**: 103843
Laluk, N. C., Montgomery, L. M., Tsosie, R., McCleave, C., Miron, R., Carroll, S. R., et al. (2022). Archaeology and social justice in Native America. *American Antiquity* **87**: 659–682.
Lambrides, A. B. J., and Weisler, I. (2016). Pacific Islands ichthyoarchaeology: Implications for the development of prehistorical fishing studies and global sustainability. *Journal of Archaeological Research* **24**: 275–324.

Lau, H., and Kansa, S. W. (2018). Zooarchaeology in the era of big data: Contending with interanalyst variation and best practices for informed use. *Journal of Archaeological Science* **95**: 33–39.

Lawler, M., Arnold, R., Robb, K. F., Herries, A. I. R., Lovett, T., Keogh, C., et al. (2014). The Browns Creek Community Archaeology Project: Preliminary results from the survey and excavation of a late Holocene shell midden on the Victorian coast. In Spry, C., Frankel, D., Lawrence, S., Berelov, S., and Canning, S. (eds.), *Excavations, Surveys and Heritage Management in Victoria*, Volume 3, La Trobe University, Melbourne, pp. 43–52.

Laws, A., Maloney, J., Klotsko, S., Gusick, A., Braje, T., and Ball, D. (2020). Submerged paleoshoreline mapping using high-resolution Chirp sub-bottom data, Northern Channel Islands platform, California, USA. *Quaternary Research* **93**: 1–22.

Leach, J., Wiseman, C., O'Leary, M., McDonald, J., McCarthy, J., Morrison, P., et al. (2021). The integrated cultural landscape of North Gidley Island: Coastal, intertidal and nearshore archaeology in Murujuga (Dampier Archipelago), Western Australia. *Australian Archaeology* **87**: 251–267. DOI: https://doi.org/10.1080/03122417.2021.1949085

LeFebvre, M. J. (2007). Zooarchaeological analysis of prehistoric vertebrate exploitation at the Grand Bay Site, Carriacou, West Indies. *Coral Reefs* **26**: 931–944.

LeFebvre, M. J., Ardren, T., Thompson, V. D., Fitzpatrick, S. M., and Ayers-Rigsby, S. (2022). In support of sustainability: The historical ecology of vertebrate biodiversity and Native American harvest practices in the Florida Keys, USA. *Sustainability* **14**: 6552.

Lefebvre, M. J., Brenskelle, L., Wieczorek, J., Kansa, S. W., Kansa, E. C., Wallis, N. J., et al. (2019). ZooArchNet: Connecting zooarchaeological specimens to the biodiversity and archaeology data networks. *PLOS One* **14(4)**: e0215369. https://doi.org/10.1371/journal.pone.0215369

Lepofsky, D., Smith, N. F., Cardinal, N., Harper, J., Morris, M., Gitla (White, E.), et al. (2015). Ancient shellfish mariculture on the Northwest Coast of North America. *American Antiquity* **80**: 236–259.

Lepofsky, D., Armstrong, C., Greening, S., Jackley, J., Carpenter, J., Guernsey, B., Matthews, D., and Turner, N. J. (2017). Historical ecology and cultural keystone places of the Northwest Coast. *American Anthropologist* **119**: 448–463.

Lewis, J. P., Ryves, D. B., Rasmussen, P., Olsen, J., van der Sluis, L. G., Reimer, P. J., et al. (2020). Marine resource abundance drove pre-agricultural population increase in Stone Age Scandinavia. *Nature Communications* **11**: 2006. https://doi.org/10.1038/s41467-020-15621-1

Li, Y., Jia, X., Liu, Z., Zhao, L., Sheng, P., and Storozum, M. (2022). The potential impact of rising sea levels on China's coastal heritage: A GIS risk assessment. *Antiquity* **96(386)**: 406–421.

Lightfoot, K. G. (1986). Shell midden diversity: A case example from coastal New York. *North American Archaeologist* **6**: 289–324.

Lightfoot, K. G., and Luby, E. M. (2012). Mound building by California hunter-gatherers. In Pauketat, T. R. (ed.), *The Oxford Handbook of North American Archaeology,* Oxford Handbooks online edition, Oxford Academic Press. https://doi.org/10.1093/oxfordhb/9780195380118.013.0018

Lightfoot, K. G., Luby, E. M., and Sanchez, G. M. (2017). Monumentality in hunter-gatherer-fisher landscapes of the greater San Francisco Bay, California. *Hunter Gatherer Research* **3**: 65–85.

Lightfoot, K., Cuthrell, R., Hylkema, M., Gifford-Gonzalez, D., Jewett, R., Grone, M., et al. (2021). The eco-archaeological investigation of Indigenous stewardship practices on the Santa Cruz coast. *Journal of California and Great Basin Anthropology* **41**: 187–205.

Llorente-Rodríguez, L., Craig, O. E., Colonese, A., von Tersch, M., Roselló-Izquiredor, E., González Gómez de Agüero, E., et al. (2022). Elucidating historical fisheries networks in the Iberian Peninsula using stable isotopes. *Fish and Fisheries* **23**: 862–873.

Loiselle, H. (2020). Humans, dolphins, and porpoises: Investigations at the Par-Tee site, Seaside, Oregon, AD 100–800. *Ethnobiology Letters* **11**: 58–66.

Lombardo, U., Szabo, K., Capriles, J. M., May, J.-H., Amelung, W., Hutterer, R., et al. (2013) Early and Middle Holocene hunter-gatherer occupations in western Amazonia: The hidden shell middens. *PLoS ONE* **8(8):** e72746. https://doi.org/10.1371/journal.pone.0072746

López de la Lama, R., de la Puente, S., and Sueiro, J. C. (2021). Reconnecting with the past and aniticipating the future: A review of fisheries-derived cultural ecosystem services in pre-Hispanic Peru. *People and Nature* **3**: 129–147.

Losey, R. J., and Yang, D. Y. (2007). Opportunistic whale hunting on the southern Northwest Coast: Ancient DNA, artifact, and ethnographic evidence. *American Antiquity* **72**: 657–676.

Luby, E. M., Drescher, C. D., and Lightfoot, K. G. (2006). Shell mounds and mounded landscapes in the San Francisco Bay area: An integrated approach. *Journal of Island and Coastal Archaeology* **1**: 191–214.

Lulewicz, I. H., Thompson, V. D., Cramb, J., and Tucker, B. (2017). Oyster paleoecology and Native American subsistence practices on Ossabaw Island, Georgia, USA. *Journal of Archaeological Science: Reports* **15**: 282–289.

Lulewicz, I. H., Wallis, N., and Thompson, V. D. (2020). Exploring the seas of mound building through oxygen isotope geochemistry at the Garden Patch site, Gulf Coast Florida, USA. *Southeastern Archeology* **39**: 16–28.

Lyman, R. L. (2012). A warrant for applied palaeozoology. *Biological Reviews* **87**: 513–525.

Lyons, N. (2013). *Where the Wind Blows Us: Practical Critical Community Archaeology in the Canadian North*, University of Arizona Press, Tucson.

Mackie, Q., Fedje, D., and McLaren, D. (2018). Archaeology and sea level change on the British Columbia coast. *Canadian Journal of Archaeology* **42**: 74–91.

Manne, T., and Veth, P. M. (2015). Late Pleistocene and early Holocene exploitation of estuarine communities in northwestern Australia. *Quaternary International* **385**: 112–123.

Mannino, M. A., and Thomas, K. D. (2002). Depletion of a resource? The impact of prehistoric human foraging on intertidal mollusc communities and its significance for human settlement, mobility, and dispersal. *World Archaeology* **33**: 452–474.

Mansur, E., and Piqué, R. (2013). Coast and hinterland: Territory and resource management of the Selknam of Tierra del Fuego. In Bailey, G., Hardy K., and Camara, A. (eds.), *Shell Energy: Mollusc Shells and Coastal Resources*, Oxbow Books, Oxford, pp. 298–307.

Marean, C. W. (2014). The origins and significance of coastal resource use in Africa and western Eurasia. *Journal of Human Evolution* **77**: 17–40.

Marean, C. W. (2016). The transition to foraging for dense and predictable resources and its impact on the evolution of modern humans. *Philosophical Transactions of the Royal Society B* **371:** 20150239.

Marean, C. W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A. I. R., et al. (2007). Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature* **449**: 905–908.

Marquardt, W. H. (2010). Shell mounds in the Southeast: Middens, monuments, temple mounds, rings, or works? *American Antiquity* **75**: 551–570.

Marquardt, W. H., and Walker, K. J. (eds.) (2013). *The Archaeology of Pineland: A Coastal Southwest Florida Site Complex, ca. AD 50–1710*, Institute of Archaeology and Paleoenvironmental Studies, Monograph 4, University of Florida, Gainesville.

Marquardt, W., and Watson, P. J. (1983). The shell mound Archaic of western Kentucky. In Phillips, J. L., and Brown, L. A. (eds.), *Archaic Hunters and Gatherers in the American Midwest*, Academic Press, Orlando, pp. 323–339.

Marquardt, W., and Watson, P. J. (2005). The Green River Shell Mound Archaic: Conclusions. In Marquardt, W., and Watson, P. J. (eds.), *Archaeology of the Middle Green River Region, Kentucky*, University Press of Florida, Gainesville, pp. 629–647.

Marquardt, W. H., Walker, K. J., Thompson, V. D., Savarese, M., Roberts Thompson, A. D., and Newsom, L. A. (2022). Episodic complexity and the emergence of a coastal kingdom: Climate, cooperation, and coercion in southwest Florida. *Journal of Anthropological Archaeology* **65**: 101364.

Mathewes, R. W., Lacourse, T., Helmer, E. F., Howarth, C. R., and Fedje, D. W. (2020). Late Pleistocene vegetation and sedimentary charcoal at Kilgii Gwaay archaeological site in coastal British Columbia, Canada, with possible proxy evidence for human presence by 13,000 cal BP. *Vegetation History and Archaeobotany* **29**: 297–307.

Matsumoto, N. (2018). Changing relationship between the dead and the living in Japanese prehistory. *Philosophical Transactions of the Royal Society B Biological Sciences* **373**: 20170272.

McAdams, C., Morley, M. W., Fu, X., Kandyba, A. V., Dereianko, A. P., Nguyen, D. T., Gia Doi, N., and Roberts, R. G. (2022). Late Pleistocene shell midden microstratigraphy indicates a complex history of human–environment interactions in the uplands of northern Vietnam. *Philosophical Transactions of the Royal Society B* **377:** 20200493 https://doi.org/10.1098/rstb.2020.0493

McAvoy, W. A., and Harrison, J. W. (2012). Plant community classification and the flora of Native American shell-middens on the Delmarva Peninsula. *The Maryland Naturalist* **52**: 1–34.

McCoy, M. D. (2018). The race to document archaeological sites ahead of rising sea levels: Recent applications of geospatial technologies in the archaeology of Polynesia. *Sustainability* **10**: 185. https://doi.org/10.3390/su10010185

McGovern, T. H. (2018). Burning libraries: A community response. *Conservation and Management of Archaeological Sites* **20**: 165–174.

McKechnie, I., and Moss, M. L. (2016). Meta-analysis in zooarchaeology expands perspectives on Indigenous fisheries of the Northwest Coast of North America. *Journal of Archaeological Science: Reports* **8**: 470–485.

McKechnie, I., Lepofsky, D., Moss, M. L., Butler, V. L., Orchard, T. J., Coupland, G., et al. (2014). Archaeological data provide alternative hypotheses on Pacific herring (*Clupea pallasii*) distribution, abundance, and variability. *Proceedings of the National Academy of Science USA* **111(9)**: E807–E816.

McKillop, H. (2023). Flooded mangrove landscapes hide ancient Maya coastal sites in Belize. *Journal of Island and Coastal Archaeology,* DOI: https://doi.org/10.1080/15564894.2022.2163323

McNiven, I. (2013). Ritualized middening practices. *Journal of Archaeological Method and Theory* **20**: 552–587.

McNiven, I. (2016). Theoretical challenges of Indigenous archaeology: Setting an agenda. *American Antiquity* **81**: 27–41.

McNiven, I. J., Crouch, J., Bowler, J., Sherwood, J., Dolby, N., and Stanisic, J. (2018). The Moyjil site, south-west Victoria: Excavation of a Last Interglacial charcoal and burnt stone feature: Is it a hearth? *Proceedings of the Royal Society of Victoria* **130**: 94–116.

Meehan, B. (1982). *Shell Bed to Shell Midden*, Australia National University, Canberra.

Meighan, C. W. (1959). The Little Harbor site, Catalina Island: An example of ecological interpretation in archaeology. *American Antiquity* **24**: 383–405.

Meigs, P. (1938). Vegetation on shell mounds, lower California. *Science* **87**: 346–346.

Méndez, C., Nuevo-Delaunay, A., Grasset, S., Maldonado, A., Seguel, R., Troncoso, A., Talep, C., and Villalón, D. (2021). Different(ial) human use of coastal landscapes: Archaeological contexts, chronology, and assemblages of El Teniente Bay (31° S, Chile, South America). *Land* **10(6)**: 577. https://doi.org/10.3390/land10060577

Milner, G.R., and Jefferies, R. W. (1998). The Read Archaic shell midden in Kentucky. *Southeastern Archaeology* **17**: 119–132.

Milner, N. (2013). Human impacts on oyster resources at the Mesolithic-Neolithic transition in Denmark. In Thompson, V. D., and Waggoner, J. C., Jr. (eds.), *The Archaeology and Historical Ecology of Small Scale Economies*, University Press of Florida, Gainesville, pp. 19–40.

Milner, N., Craig, O., and Bailey, G. (2007a). Shell middens in Atlantic Europe. In Milner, N., Craig, O., and Bailey, G. (eds.), *Shell Middens in Atlantic Europe*, Oxbow Books, Oxford, pp. 1–4.

Milner, N., Craig, O., and Bailey, G. (eds.) (2007b). *Shell Middens in Atlantic Europe*. Oxbow Books, Oxford.

Misarti, N., Finney, B. P., Maschner, H., and Wooler, M. (2009). Changes in Northeast Pacific marine ecosystems over 4,500 years: Evidence from stable isotope analysis of bone collagen from archaeological middens. *The Holocene* **19**: 1139–1151.

Misarti, N., Gier, E., Finney, B., Barnes, K., and McCarthy, M. (2017). Compound-specific amino acid δ^{15}N values in archaeological shell: Assessing diagenetic integrity and potential for isotopic baseline reconstruction. *Rapid Communications in Mass Spectrometry* **31**: 1881–1891.

Mitchell, J., and Childress, M. R. (2021). Applying zooarchaeology: Environmental and ecological perspectives from a prehistoric freshwater mussel assemblage on the Yazoo River, western Mississippi, USA. *Archaeological and Anthropological Sciences* **13**: 88.

Mitchell, P. J. (2023). Archaeological research in the Canary Islands: Island archaeology off Africa's Atlantic Coast. *Journal of Archaeological Research*, in press.

Monks, C. (2021). The role of terrestrial, estuarine, and marine foods in dynamic Holocene environments and adaptive coastal economies in southwestern Australia. *Quaternary International* **597**: 5–23.

Moore, C. B. (1916). Some aboriginal sites on the Green River, Kentucky. *Journal of the Academy of Natural Sciences of Philadelphia* **16**: 431–511.

Moore, C. R., and Thompson, V. D. (2012). Animism and Green River persistent places: A dwelling perspective of the Shell Mound Archaic. *Journal of Social Archaeology* **12**: 264–284.

Morales-Muñiz, A., and Roselló-Izquierdo, E. (2008). Twenty thousand years of fishing in the strait: Archaeological fish and shellfish assemblages from southern Iberia. In Rick, T. C., and Erlandson, J. M. (eds.), *Human Impacts on Ancient Marine Ecosystems: A Global Perspective*, University of California Press, Berkeley, pp. 243–277.

Morlot, A. V. (1861). General views on archaeology. In *Annual Report of the Smithsonian Institution for 1860*, Smithsonian Institution, Washington, DC, pp. 284–343.

Morrison, M. (2013). From scatter to mound: A new developmental model for shell mound sites at Weipa. *Queensland Archaeological Research* **16**: 165–184.

Morse, E. S. (1877). *Shell Mounds of Omori, Near Tokyo Japan*, Imperial University, Tokyo.
Moss, M. L. (1990). Shellfish, gender, and status on the Northwest Coast: Reconciling archaeological, ethnographic, and ethnohistoric records of the Tlingit. *American Anthropologist* **95**: 631–652.
Moss, M. L. (2011). *Northwest Coast: Archaeology as Deep History*, Society for American Archaeology, Washington, DC.
Moss, M. L. (2020). Did Tlingit ancestors eat sea otters? Addressing intellectual property and cultural heritage through zooarchaeology. *American Antiquity* **85**: 202–221.
Nagaoka, L., and Allen, M. (2009). Antipodean perspectives on zooarchaeology: Behavioral ecology, taphonomy, and applied research. *Journal of Island and Coastal Archaeology* **4**: 164–176.
Nelson, P. (2021). The role of GPR in community-driven compliance archaeology with tribal and non-tribal communities in central California. *Advances in Archaeological Practice* **9**: 215–225.
Newsom, B., Lolar, N. D., and St. John, I. (2021). In conversation with the ancestors: Indigenizing archaeological narratives at Acadia National Park, Maine. *Genealogy* **5**: 96. https://doi.org/10.3390/genealogy5040096
Newsom, B., Soctomah, D., Blackwood, E., and Brough, J. (2023). Indigenous archaeologies, shell heaps, and climate change resilience: A case study from Passamaquoddy Homeland. *Advances in Archaeological Practice* **11**, in press.
Niespolo, E. M., Sharp, W. D., Avery, G., and Dawson, T. E. (2021). Early, intensive marine resource exploitation by Middle Stone Age humans at Ysterfontein 1 rockshelter, South Africa. *Proceedings of the National Academy of Sciences USA* **118**: e2020042118.
Nye, J. W., Zangrando, A. F. J., Martinoli, M. P., and Fogel, M. L. (2020). Temporal and population trends in human exploited pinnipeds from Tierra del Fuego. *Palaeogeography, Palaeoclimatology, and Palaeoecology* **554**: 109804.
O'Connell, J. F., and Allen, J. 2012. The restaurant at the end of the universe: Modeling the colonization of Sahul. *Australia Archaeology* **74**: 5–17.
O'Connor, S., Spriggs, M., and Veth, P. (2002). Excavation at Lene Hara Cave establishes occupation in East Timor at least 30,000–35,000 years ago. *Antiquity* **76**: 45–49.
O'Connor, S., Ono, R., and Clarkson, C. (2011). Pelagic fishing at 42,000 years before the present and the maritime skills of modern humans. *Science* **334**: 117–1121.
Oertle, A., Szabó, K., Gaqa, S., Cawthra, H. C., Esteban, I., Pargeter, J., and Fisher, E. C. (2022). Peering into the unseen: Novel methods in identifying shell taxa from archaeological micro-fragments. *Journal of Archaeological Science* **147**: 105667.
Orton, D. C. (2016). Archaeology as a tool for understanding past marine resource use and its impact. In Máñez Schwerdtner, K., and Poulsen, B. (eds.), *Perspectives on Oceans Past*, Springer, Dordrecht, pp. 47–69.
Palmer, E., Tushingham, S., and Kemp, B. (2018). Human use of small forage fish: Improved ancient DNA species identification techniques reveal long term record of sustainable mass harvesting of smelt fishery in the northeast Pacific Rim. *Journal of Archaeological Science* **99**: 143–152.
Parker, W. G., Yanes, Y., Mesa Hernández, E., Hernández Marrero, J. C., Pais, J., Soto, N., and Surge, D. (2020). Shellfish exploitation in the western Canary Islands over the last two millennia. *Environmental Archaeology* **25:** 14–36.
Parkington, J. (1976). Coastal settlement between the mouths of the Berg and Olifants Rivers, Cape Province. *South African Archaeological Bulletin* **31**: 127–140.
Parkington, J., and Brand, R. (2020). Shell middens and coastal prehistory. In *Oxford Research Encyclopedia of Anthropology*. https://doi.org/10.1093/acrefore/9780190854584.013.48
Parkington, J., Kyriacou, K., and Fisher, J. Jr. (2015). Late Holocene settlement along the Atlantic Coast of the Cape: Megamiddens and the case for and against human population increase. *South African Archaeological Bulletin* **70**: 124–130.
Parmalee, P. W., and Klippel, W. E. (1974). Freshwater mussels as a prehistoric food resource. *American Antiquity* **39**: 421–434.
Peacock, E., Randklev, C. R., Wolverton, S., Palmer, R. A., and Zaleski, S. (2012). The "cultural filter," human transport of mussel shell, and the applied potential of zooarchaeological data. *Ecological Applications* **22**: 1446–1459.
Pluckhahn, T. J., Thompson, V. D., and Cherkinsky, A. (2015). The temporality of shell-bearing landscapes at Crystal River, Florida. *Journal of Anthropological Archaeology* **37**: 19–36.
Pluckhahn, T. J., Thompson, V. D., and Rink, W. J. (2016). Evidence for stepped pyramids of shell in the Woodland period of eastern North America. *American Antiquity* **81**: 345–363.

Prestes-Carneiro, G., Béarez, P., Pugliese, F., Shock, M. P., Zimpel, C. A., Pouilly, M., and Neves, E. G. (2020). Archaeological history of Middle Holocene environmental change from fish proxies at the Monte Castelo archaeological shell mound, southwestern Amazonia. *The Holocene* **30:** 1606–1621.

Rabett, R., Appleby, J., Blyth, A., Farr, L., Gallou, A., Griffiths, T., et al. (2011). Inland shell midden site-formation: Investigation into a late Pleistocene to early Holocene midden Tràng An, Northern Vietnam. *Quaternary International* **239**: 153–169.

Radde, H. D. (2020). Sea lion hunting strategies among late Holocene hunter-gatherer-fishers on Santa Catalina Island, California, USA. *Quaternary International* **597**: 24–36.

Rahman, N., Ismail, N. A., and Saidin, M. (2019). Shell mound investigation at Guar Kepah (Penang, Malaysia) using 2-D resistivity imaging for archaeological study. *Journal of Physical Science* **30**: 17–23.

Randall, A. (2015a). How Jeffries Wyman put Florida shell mounds on the map (1860–1875). *Bulletin of the History of Archaeology* **25**: 1–12.

Randall, A. (2015b). *Constructing Histories: Archaic Freshwater Mounds and Social Landscapes of the St. Johns River, Florida*, University Press of Florida, Gainesville.

Randall, A., and Sassaman, K. (2017). Terraforming the middle ground in ancient Florida. *Hunter Gatherer Research* **3**: 9–29.

Reeder-Myers, L. A. (2015). Cultural heritage at risk in the twenty-first century: A vulnerability assessment of coastal archaeological sites in the United States. *Journal of Island and Coastal Archaeology* **10**: 436–445.

Reeder-Myers, L. A., and Rick, T. C. (2019). Kayak surveys in estuarine environments: Addressing sea-level rise and climate change. *Antiquity* **370:** 1040–1051.

Reeder-Myers, L., Braje, T., Hofman, C., Elliott Smith, E., Garland, C., Grone, M., et al. (2022). Indigenous oyster fisheries persisted for thousands of years and should inform future management. *Nature Communications* **13** (2383). https://doi.org/10.1038/s41467-022-29818-z

Reyes, O., Méndez, C., San Román, M., Belmar, C., and Nuevo-Delaunay, A. (2022). Biogeographic barriers in the circulation and interaction of hunter-gatherer marine fishers: The role of the Taitao Peninsula and the Gulf of Penas (~ 47° S) in the differentiation of the cultural trajectories of West Patagonia. *Frontiers in Earth Science* **10**: 946732. doi: https://doi.org/10.3389/feart.2022.946732

Rick, T. C. (2013). Hunter-gatherers, endemic island mammals, and the historical ecology of California's Channel Islands. In Thompson, V. D., and Waggoner Jr., J. (eds.), *The Archaeology and Historical Ecology of Small Scale Economies*, University Press of Florida, Gainesville, pp. 41–64.

Rick, T. C., Kirch, P. V., Fitzpatrick, S. M., and Erlandson, J. M. (2013). Archaeology, deep history, and the human transformation of island ecosystems. *Anthropocene* **4**: 33–45.

Rick, T. C., Reeder-Myers, L., Breitburg, D., Lockwood, R., Hofman, C. A., Henkes, G., et al. (2016). Millennial-scale sustainability of the Chesapeake Bay Native American oyster fishery. *Proceedings of the National Academy of Sciences USA* **113**: 6568–6573.

Rick, T. C., Braje, T. J., Graham, L., Easterday, K., Hofman, C., Holguin, B., Reeder-Myers, L., and Reynolds, M. (2022). Cultural Keystone Places and the Chumash landscapes of Kumqaq', Point Conception, California. *American Antiquity* **87**: 487–504.

Rivera-Collazo, I. C. (2020). Severe weather and the reliability of desk-based vulnerability assessments: The impact of Hurricane Maria to Puerto Rico's coastal archaeology. *Journal of Island and Coastal Archaeology* **15**: 244–263.

Roberts, P., Stock, J., Kulatilake, S., Boivin, N., Petraglia, M. D., Deraniyagala, S., and Perera, N. (2022). From the forests to the coast—Multidisciplinary investigation of human adaptations at the Mini-athiliya shell midden, Sri Lanka. *Ancient Lanka* **1.** https://doi.org/10.29173/anlk650

Robson, H. K., Hausmann, N., and Milner, N. (2023). Shell middens. In *Reference Module in Social Sciences*.https://doi.org/10.1016/B978-0-323-90799-6.00028-8

Roksandic, M., Mendonça de Souza, S., Eggers, S., Burchell, M., and Klokler, D. (eds.) (2014). *The Cultural Dynamics of Shell Matrix Sites*, University of New Mexico Press, Albuquerque.

Rowland, M., Shaw, B., and Ulm, S. (2021). Maritime coastal and island societies of Australia and New Guinea. In McNiven, I. J., and David, B. (eds.), *The Oxford Handbook of the Archaeology of Indigenous Australia and New Guinea* (online edition), Oxford Academic. https://doi.org/10.1093/oxfordhb/9780190095611.013.29

Salazar, D., Easton, G., Guendon, J. L., González-Alfaro, J., Andrade, P., Villagrán, X., et al. (2022). Did a 3800-year-old M_w ~9.5 earthquake trigger major social disruption in the Atacama Desert? *Science Advances* **8**: eabm2996. https://doi.org/10.1126/sciadv.abm2996

Sanchez, G. M., Gobalet, K., Jewett, R., Cuthrell, R. Q., Grone, M., Engel, P. M., and Lightfoot, K. G. (2018a). The historical ecology of central California coast fishing: Perspectives from Point Reyes National Seashore. *Journal of Archaeological Science* **100**: 1–15.

Sanchez, G. M., Rick, T. C., Culleton, B. J., Kennett, D. J., Buckley, M., Erlandson, J. M., and Losey, R. J. (2018b). Radiocarbon dating legacy collections: A Bayesian analysis of high-precision AMS 14C dates from the Par-Tee site, Oregon. *Journal of Archaeological Science: Reports* **21**: 833–848.

Sanchez, G. M., Grone, M. A., Apodaca, A. J., Byram, R. S., Lopez, V., and Jewett, R. A. (2021). Sensing the past: Perspectives on collaborative archaeology and ground penetrating radar techniques from coastal California. *Remote Sensing* **13**: 285.

Sanchez, G. M., Gobalet, K., and Rick, T. C. (2022). New insights on the Par-Tee (35CLT20) site: Collections-based research of northern Oregon coast fisheries. *Journal of Island and Coastal Archaeology* **17**: 274–296.

Sandweiss, D. H. (2003). Terminal Pleistocene through Mid-Holocene archaeological sites as paleoclimatic archives for the Peruvian coast. *Palaeogeography, Palaeoclimatology, Palaeoecology* **194**: 23–40.

Sandweiss, D. H., Andrus, C. F. T., Kelley, A. R., and Roscoe, P. B. (2020). Archaeological climate proxies and complexities of reconstructing Holocene El Niño in coastal Peru. *Proceedings of the National Academy of Sciences USA* **117:** 8271–8279.

Sanger, M. C. (2021). Joining the circle: Native American philosophy applied to the study of Late Archaic shell rings of the southeast United States. *Journal of Archaeological Method and Theory* **28**: 737–765.

Sanger, M. C., Quitmyer, I. R., Colaninno, C. E., Cannarozzi, N., and Ruhl, D. L. (2020). Multi-proxy seasonality indicators: An approach to assess shell midden formation from Late Archaic shell rings in the coastal southeast North America. *Journal of Island and Coastal Archaeology* **15**: 333–363.

Sanger, M. C., Seeber, K., Bourcy, S., Galdun, J., Troutman, M., Mahar, G., Pietras, J. T., and Kelly, C. (2021). Revelatory locales: The ritual reuse of a Late Archaic shell ring in South Carolina. *Journal of Anthropological Archaeology* **64**: 101356.

Sassaman, K. E. (1995). The cultural diversity of interactions among mid-Holocene societies of the American Southeast. In Nassaney, M. S., and Sassaman, K. E. (eds.), *Native American Interactions: Multiscalar Analyses and Interpretations in the Eastern Woodlands*, University of Tennessee Press, Knoxville, pp. 174–204.

Sassaman, K. E. (2004). Complex hunter-gatherers in evolution and history: A North American perspective. *Journal of Archaeological Research* **12**: 227–280.

Sassaman, K. E., Wallis, N. J., McFadden, P. S., Mahar, G. J., Jenkins, J. A., Donop, M. C., et al. (2017). Keeping pace with rising sea: The first 6 years of the Lower Suwannee archaeological survey, Gulf Coastal Florida. *Journal of Island and Coastal Archaeology* **12**: 173–199.

Sassaman, K. E., Blessing, M. E., Goodwin, J. M., Jenkins, J. A., Mahar, G. J., Boucher, A., Barbour, T. E., and Donop, M. C. (2020). Maritime ritual economies of cosmic synchronicity: Summer solstice events at a civic-ceremonial center on the northern Gulf Coast of Florida. *American Antiquity* **85**: 22–50.

Saunders, R., Wrenn, J. H., Krebs, W., and Bryant, V. M. (2009). Coastal dynamics and cultural occupations on Choctawatchee Bay, Florida, USA. *Palynology* **33**: 133–156.

Savarese, M., Walker, K. J., Stingu, S., Marquardt, W. H., and Thompson, V. D. (2016). The effects of shellfish harvesting by aboriginal inhabitants of southwest Florida (USA) on productivity of the eastern oyster: Implications for estuarine management and restoration. *Anthropocene* **16**: 28–41.

Sawbridge, D. F., and Bell, M. A. M. (1972). Vegetation and soils of shell middens on the coast of British Columbia. *Ecology* **53**: 840–849.

Saunders, R., and Russo, M. (2011). Coastal shell middens in Florida: A view from the Archaic period. *Quaternary International* **239**: 38–50.

Schang, K., Cox, K., and Trant, A. (2022). Habitation sites influence tree community assemblages in the Great Bear Rainforest, British Columbia, Canada. *Frontiers in Ecology and Evolution* **9**: 791047.

Scheel-Ybert, R., and Boyadijan, C. (2020). Gardens on the coast: Considerations on food production by Brazilian shellmound builders. *Journal of Anthropological Archaeology* **60**: 101211.

Schneider, T. D. (2015). Placing refuge and the archaeology of Indigenous hinterlands in colonial California. *American Antiquity* **80**: 695–713.

Schneider, T. D. (2021). *The Archaeology of Refuge and Recourse: Coast Miwok Resilience and Indigenous Hinterlands in Colonial California*, University of Arizona Press, Tucson.
Schneider, T. D., Janzen, A., Deantoni, G. M., Hill, A. M., Apodaca, A. J., and Cuthrell, R. Q. (2018). Indigenous persistence and foodways at the Toms Point Trading Post (CA-MRN-202), Tomales Bay, California. *Journal of California and Great Basin Anthropology* **38**: 51–73.
Schwadron, M. (2017). Shell works: Prehistoric terraformed communities of the Ten Thousand Islands, Florida. *Hunter Gatherer Research* **3**: 31–63.
Seeto, J., Nunn, P. D., and Sanjan, S. (2012). Human-mediated prehistoric marine extinction in the tropical Pacific? Understanding the presence of *Hippopus hippopus* (Linn. 1758) in ancient shell middens on the Rove Peninsula, Fiji. *Geoarchaeology* **27**: 2–17.
Shiner, J. S., Fanning, P. C., Holdaway, S. J., Petchey, F., Beresford, C., Hoffman, E., and Larsen, B. (2013). Shell mounds as the basis for understanding human-environment interactions in far north Queensland, Australia. *Queensland Archaeological Research* **16**: 65–92.
Siegel, P. E. (ed.) (2018). *Island Historical Ecology: Socionatural Landscapes of the Eastern and Southern Caribbean*, Berghahn Books, New York.
Silliman, S. W., and Sebastian Dring, K. H. (2008). Working on pasts for futures: Eastern Pequot field school archaeology in Connecticut. In Silliman, S. W. (ed.), *Collaborating at the Trowel's Edge: Teaching and Learning in Indigenous Archaeology*, University of Arizona Press, Tucson, pp. 67–87.
Skriver, C., Borup, P., and Astrup, P. M. (2017). Hjarnø Sund: An eroding Mesolithic site and the tale of two paddles. In Bailey, G. N., Harff, J., and Sakellariou, D. (eds.), *Under the Sea: Archaeology and Palaeolandscapes of the Continental Shelf*, Springer, Cham, pp. 131–143.
Slade, E., McKechnie, I., and Salomon, A. K. (2022). Archaeological and contemporary evidence indicates low sea otter prevalence on the Pacific Northwest Coast during the Late Holocene. *Ecosystems* **25**: 548–566.
St. Amand, F., Childs, S. T., Reitz, E. J., Heller, S., Newsom, B., Rick, T. C., Sandweiss, D. H., and Wheeler, R. (2020). Leveraging legacy archaeological collections as proxies for climate and environmental research. *Proceedings of the National Academy of Sciences USA* **117**: 8287–8294.
Stalter, R., and Kincaid, D. (2004). The vascular flora of five Florida shell middens. *Journal of the Torrey Botanical Society* **131**: 93–103.
Stalter, R., Leyva, M., and Kincaid, D. (1999). The flora of Indian shell rings from coastal South Carolina to northern Florida. *Sida* **18:** 861–875.
Stein, J. K. (1992). The analysis of shell middens. In Stein, J. K. (ed.), *Deciphering a Shell Midden*, Academic Press, San Diego, pp. 1–24.
Stratham, E. J. (1892). Observations on shell-heaps and shell-beds. *Journal of the Royal Society of New South Wales* **26**: 304–314.
Stringer, C. B., Finlayson, J. C., Barton, R. N. E., Fernández-Jalvo, Y., Cáceres, I., Sabin, R. C., et al. (2008). Neanderthal exploitation of marine mammals in Gibraltar. *Proceedings of the National Academy of Sciences USA* **105**: 14319–14324.
Szabó, K. (2017). Shell middens. In Gilbert, A. S. (ed.), *Encyclopedia of Geoarchaeology*, Springer, Dordrecht, pp. 772–788.
Szabó, K., Dupont, C., Dimitrijevic, V., Gómez Gastélum, L., and Serrand, N. (eds.) (2014). *Archaeomalacology: Shells in the Archaeological Record*, BAR International Series 2666, BAR Publishing, Oxford.
Szpak, P., Orchard, T. J., McKechnie, I., and Gröcke, D. (2012). Historical ecology of late Holocene sea otters (*Enhydra lutris*) from northern British Columbia: Isotopic and zooarchaeological perspectives. *Journal of Archaeological Science* **39**: 1553–1571.
Taylor, V. K., and Bell, M. (2017). Land mollusc middens. In Allen, M. J. (ed.), *Molluscs in Archaeology*, Oxbow Books, Oxford, pp. 195–212.
Terrell, J. E. (1967). Galatea Bay—the excavation of a beach-stream midden site on Ponui Island in the Huaraki Gulf, New Zealand. *Transactions of the Royal Society of New Zealand* **2**: 31–70.
Thakar, H. B. (2012). Ancient actions predict modern consequences: Lessons from prehistoric shellfish intensification. In Wolverton, S., and Lyman, R. L. (eds.), *Conservation Biology and Applied Zooarchaeology*, University of Arizona Press, Tucson, pp. 92–109.
Thiam, M. (2013). Sengambian shell middens and burials—a heritage in danger. In Bailey, G., Hardy, K., and Camara, A. (eds.), *Shell Energy: Mollusc Shells and Coastal Resources*, Oxbow Books, Oxford, pp. 191–198.

Thiel, B. (1983). Excavations at the Lal-lo shellmiddens, northeast Luzon, Philippines. *Asian Perspectives* **28**:71–94.

Thomas, D. H. (2008). *Native American Landscapes of St. Catherine's Island, Georgia*, Volumes 1–3, Anthropological Papers 88, American Museum of Natural History, New York.

Thomas, K. D. (2015a). Molluscs emergent, part I: Themes and trends in the scientific investigation of mollusc shells as resources for archaeological research. *Journal of Archaeological Science* **56**: 133–140.

Thomas, K. D. (2015b). Molluscs emergent, part II: Themes and trends in the scientific investigation of molluscs and their shells as past human resources. *Journal of Archaeological Science* **56**: 159–167.

Thomas, K. D. (2019). Sustainable extractive strategies in the pre-European contact Pacific: Evidence from mollusk resources. *Journal of Ethnobiology* **39:** 240–261.

Thompson, V. D. (2022). Considering ideas of collective action, institutions, and "hunter-gatherers" in the American Southeast. *Journal of Archaeological Research.*https://doi.org/10.1007/s10814-022-09179-3

Thompson, V. D., and Andrus, C. F. T. (2011). Evaluating mobility, monumentality, and feasting at the Sapelo Island Shell Ring Complex. *American Antiquity* **76**: 315–343.

Thompson, V. D., and Worth, J. E. (2011). Dwellers by the sea: Native American along the southern coasts of eastern North America. *Journal of Archaeological Research* **19**: 51–101.

Thompson, V. D., Marquardt, W. H., Cherkinsky, A., Roberts Thompson, A. D., Walker, K. J., Newsom, L. A., and Savarese, M. (2016). From shell midden to midden-mound: The geoarchaeology of Mound Key, an anthropogenic island in southwest Florida, USA. *PLoS ONE* **11(4)**: e0154611. https://doi.org/10.1371/journal.pone.0154611

Thompson, V. D., Marquardt, W. H., Walker, K. J., Roberts Thompson, A. D., and Newsom, L. A. (2018). Collective action, state building, and the rise of the Calusa, southwest Florida, USA. *Journal of Anthropological Archaeology* **51**: 28044.

Thompson, V., Rick, T., Garland, C., Thomas, D. H., Smith, K., Bergh, S., et al. (2020a). Ecosystem stability and Native American oyster harvesting along the Atlantic Coast of the United States. *Science Advances* **6(28)**: eaba9652.

Thompson, V. D., Marquardt, W. H., Savarese, M., Walker, K. J., Newsom, L. A., Lulewicz, I., et al. (2020b). Ancient engineering of fish capture and storage in southwest Florida. *Proceedings of the National Academy of Sciences USA* **117**: 8374–8381.

Thornton, T. F., and Moss, M. L. (2021). *Herring and People of the North Pacific: Sustaining a Keystone Species*, University of Washington Press, Seattle.

Tieng, F. S. (2015). The Guar Kepah shell middens: Evidence and questions. In Tan, N. H. (ed.), *Advancing Southeast Asian Archaeology*, SAEMO SPAFA Regional Center for Archaeology and Fine Arts, Thailand, pp. 114–139.

Tonielo, G., Lepofsky, D., Lertzman-Lepofsky, G., Salomon, A. K., and Rowell, K. (2019). 11,500 y of human-clam relationships provide long-term context for intertidal management in the Salish Sea, British Columbia. *Proceedings of the National Academy of Sciences USA* **116**: 22106–22114.

Trant, A., Wiebe, N., Hoffman, K., Mathews, D. L., McLaren, D., Nelson, T. A., and Starzomski, B. M. (2016). Intertidal resource use over millennia enhances forest productivity. *Nature Communications* **7**: 12491.

Traversat, G., Molle, G., Conte, E., and Salvat, B. (2023). An archaeomalacological investigation of chitons on the Hane Dune site, Ua Huka, Marquesas Islands. *Journal of Island and Coastal Archaeology*. https://doi.org/10.1080/15564894.2021.1986177

Treganza, A. E., and Cook, S. F. (1948). The quantitative investigation of aboriginal sites: Complete excavation with physical and archaeological analysis of a single mound. *American Antiquity* **13**: 287–297.

Trigger, B. (1986). *Native Shell Mounds of North America: The Early Years*, Garland, New York.

Tushingham, S., Hopt, J., Christiansen, C., Bommelyn, M. L., Green, J., Peterson, M. R., Steinruck, S., and Stewart, C. (2020). In the footsteps of Amelia Brown: Collaborative historical ecology at Shin-yvslh-sri~, a Tolowa village on the north coast of California. *Journal of Island and Coastal Archaeology* **15**: 3–27.

Uhle, M. (1907). *The Emeryville Shellmound,* University of California Publications in American Archaeology and Ethnology **7**: 1–106.

Ulm, S. (2006). *Coastal Themes: An Archaeology of the Southern Curtis Coast, Queensland*, Terra Australis 24, ANU Press, Canberra.

Ulm, S., McNiven, I. J., Aird, S. J., and Lambrides, A. B. J. (2019). Sustainable harvesting of *Conomurex luhuanus* and *Rochia nilotica* by Indigenous Australians on the Great Barrier Reef over the past 2000 years. *Journal of Archaeological Science: Reports* **28:** 102017.

Vanderplank, S. E., Mata, S., and Ezcurra, E. (2014). Biodiversity and archaeological conservation connected: Aragonite shell middens increase plant diversity. *BioScience* **64**: 202–209.

Vellanoweth, R. L., Porcayo-Michelini, A., Guttenberg, R. B., Hayden, W., Ainis, A. F., and Hernández-Estrada, R. (2022). Spring tides, storm surges, and the destruction of coastal middens: A case study from the upper Gulf of California, México. *Journal of Island and Coastal Archaeology* **17**: 420–431.

Veth, P., Ward, I., Manne, T., Ulm, S., Ditchfield, K., Dortch, J., and Kendrick, P. (2017). Early human occupation of a maritime desert, Barrow Island, north-west Australia. *Quaternary Science Reviews* **168**: 19–29.

Villagran, X. S. (2014). A redefinition of waste: Deconstructing shell and fish mound formation among coastal groups of southern Brazil. *Journal of Anthropological Archaeology* **36**: 211–227.

Villagran, X. S. (2019). The shell midden conundrum: Comparative micromorphology of shell-matrix sites from South America. *Journal of Archaeological Method and Theory* **26**: 344–395.

Villagran, X. S., and Giannini, P. C. F. (2014). Shell mounds as environmental proxies on the southern coast of Brazil. *The Holocene* **24**: 1009–1016.

Villagran, X. S., Klokler, D., Peixoto, S., DeBlasis, P., and Giannini, P. C. F. (2011). Building coastal landscapes: Zooarchaeology and geoarchaeology of Brazilian shell mounds. *Journal of Island and Coastal Archaeology* **6**: 211–234.

Voorhies, B. (ed.) (2015). *An Archaic Mexican Shellmound and Its Entombed Floors*, Cotsen Institute of Archaeology, University of California, Los Angeles.

Voorhies, B., and Martínez-Tagüeña, N. (2018). Clamming up: An ethnoarchaeological study of a Costa Rican artisanal clam fishery. *Journal of Island and Coastal Archaeology* **13**: 43–65.

Wake, T. A., Doughty, D. R., and Kay, M. (2013). Archaeological investigations provide late Holocene baseline ecological data for Bocas del Toro, Panama. *Bulletin of Marine Science* **89**: 1015–1035.

Ward, I., Moe-Astrup, P., and Merigot, K. (2019). At the water's edge: Micromorphological and quantitative mineral analysis of a submerged Mesolithic shell midden at Hjarnø Sund, Denmark. *Journal of Archaeological Science* **102**: 11–25.

Ward, I., Bastos, A., Carabias, D., Cawthra, H., Farr, H., Green, A., and Sturt, F. (2022). Submerged palaeolandscapes of the Southern Hemisphere (SPLOSH) – What is emerging from the Southern Hemisphere. *World Archaeology* **54**: 6–28.

Warner, J., and Alaica, A. K. (2022). Contextualizing the influence of climate and culture on bivalve populations: *Donax obesulus* malacology from the north coast of Peru. *Journal of Island and Coastal Archaeology*. DOI: https://doi.org/10.1080/15564894.2021.1991055

Waselkov, G. A. (1987). Shellfish gathering and shell midden archaeology. *Advances in Archaeological Method and Theory* **10**: 93–210.

Watkins, J. (2000). *Indigenous Archaeology: American Indian Values and Scientific Practice*, Altamira Press, Walnut Creek.

Wellman, H. P., Austin, R. M., Dagtas, Dagtas, N. D., Moss, M. L., Rick, T. C., and Hofman, C. A. (2020). Archaeological mitogenomes illuminate the historical ecology of sea otters (*Enhydra lutris*) and the viability of reintroduction. *Proceedings of the Royal Society B* **287**: 20202343.

Wells, L. E. (2001). Archaeological sediments in coastal environments. In Stein, J. K., and Farrand, W. R. (eds.), *Sediments in Archaeological Context*, University of Utah Press, Salt Lake City, pp. 149–182.

West, C. F., Hofman, C. A., Ebbert, S., Martin, J., Shirazi, S., Dunning, S., and Maldonado, J. E. (2017). Integrating archaeology and ancient DNA analysis to address invasive species colonization in the Gulf of Alaska. *Conservation Biology* **31**: 1163–1172.

West, C. F., Burchell, M., and Andrus, C F. T. (2018). Molluscs and paleoenvironmental reconstruction in island and coastal settings: Variability, seasonality, and sampling. In Giovas, C. M., and LeFebvre, M. J. (eds.), *Zooarchaeology in Practice: Case Studies in Methodology and Interpretation in Archaeofaunal Analysis*, Springer, Cham, pp. 191–208.

Westley, K., Andreou, G., El Safadi, C., Huigens, H. O., Nikolaus, J., Ortiz-Vazquez, R., et al. (2022). Climate change and coastal archaeology in the Middle East and North Africa: Assessing past impacts and future threats. *Journal of Island and Coastal Archaeology*, in press.

Whitaker, A. R. (2008). Incipient aquaculture in prehistoric California? Long-term productivity and sustainability vs. immediate returns for the harvest of marine invertebrates. *Journal of Archaeological Science* **35**: 1114–1123.

White, J. A., Burgess, G. H., Nakatsukasa, M., Hudson, M. J., Pouncett, J., Kusaka, S., et al. (2021). 3000-year-old shark attack victim from Tsukumo shell-mound, Okayama, Japan. *Journal of Archaeological Science: Reports* **38**: 103065.
Widmer, R. (1989). Archaeological research strategies in the investigation of shell-bearing sites, a Florida perspective. Paper presented at the 54th Society for American Archaeology Annual Meeting, Atlanta, GA.
Will, M. (2020). Neandertal surf and turf. *Science* **367**: 1422–1423.
Will, M., Kandel, A. W., Kyriacou, K., and Conard, N. J. (2016). An evolutionary perspective on coastal adaptations by modern humans during the Middle Stone Age of Africa. *Quaternary International* **404**: 68–86.
Will, M., Kandel, A. W., and Conard, N. J., (2019). Midden or molehill: The role of coastal adaptations in human evolution and dispersal. *Journal of World Prehistory* **32**: 33e72.
Will, M., Bader, G. D., Sommer, C., Cooper, A., and Green, A. (2022), Coastal adaptations on the eastern seaboard of South Africa during the Pleistocene and Holocene? Current evidence and future perspectives from archaeology and marine geology. *Frontiers in Earth Science* **10**: 964423. doi: https://doi.org/10.3389/feart.2022.964423
Wolverton, S., Nagaoka, L., and Rick, T. (2016): *Applied Zooarchaeology: Five Case Studies*, Elliot Werner Press, Clinton Corners, NY.
Woodman, P. (2013). Shell energy: An overview. In Bailey, G., Hardy, K., and Camara, A. (eds.), *Shell Energy: Mollusc Shells and Coastal Resources*, Oxbow Books, Oxford, pp. 298–307.
Wurz, S., Pickering, R., and Mentzer, S. M. (2022), U-Th dating, taphonomy, and taxonomy of shell middens at Klasies River main site indicate stable and systematic coastal exploitation by MIS 5c-d. *Frontiers in Earth Science* **10**: 1001370. doi: https://doi.org/10.3389/feart.2022.1001370
Wyman, J. (1868). An account of some køkkenmøddings, or shell heaps, in Maine and Massachusetts. *The American Naturalist* **1**: 561–584.
Zangrando, A. F. J. (2018). Shell middens and coastal archaeology in southern South America. In Smith, C. (ed.), *Encyclopedia of Global Archaeology*, Springer. https://doi.org/10.1007/978-3-319-51726-1_3024-1
Zazzo, A., Munoz, O., Badel, E., Béguier, I., Genchi, F., and Marcucci, L. (2016). A revised radiocarbon chronology of the Aceramic shell midden of Ra's Al-Hamra 6 (Muscat, Sultanate of Oman): Implication for occupational sequence, marine reservoir age, and human mobility. *Radiocarbon* **58(2):** 383–395.
Zhang, Y., Huang, S., Chen, W., Qin, F., Pu, X., Wei, W., et al. (2020). Early Holocene phytolith records for three shell midden sites, Yongjiang River, Guangxi Province, China. *The Holocene* **31**: 95–107.
Zhao, L. (2019). Subsistence patterns associated with shell middens from the pre-Qin period in the coastal region of China. In Wu, C., and Rolett, B. V. (eds.), *Prehistoric Maritime Cultures and Seafaring in East Asia*, Springer, Singapore, pp. 89–101.
Zilhão, J., Angelucci, D. E., Arújo Igreja, M., Arnold, L. J., Badal, E., Callapez, P., et al. (2020). Last Interglacial Iberian Neandertals as fisher-hunter-gatherers. *Science* **367**: eaaz7943.

Bibliography of Recent Literature

Allelly, K., Holdaway, S. J., Fanning, P., and Bailey, G. (2021). Beyond consumption and discard: A comparative sedimentological analysis of two shell deposits from Albatross Bay, Australia, and the Farasan Islands, Saudi Arabia. *Quaternary International* **584**: 44–58.
Allen, H., Karstens, S., and Littleton, J. (2023). Legacy archaeology: Aboriginal subsistence response to Holocene environmental changes using faunal evidence from archaeological sites on the Lower Murray, South Australia. *The Holocene*. https://doi.org/10.1177/09596836221145384
Bailey, G., Galanidou, N., Peeters, H., Joens, H., and Mennenga, M. (eds.) (2021). *The Archaeology of Europe's Drowned Landscapes*, Springer, New York.
Bicho, N., Detry, C., Price, T. D., and Cunha, E. (eds.) (2015). *Muge 150th: The 150th Anniversary of the Discovery of Mesolithic Shellmiddens*, Volume 1, Cambridge Scholars Publishing, Newcastle.
Boivin, N., Crassard, R., and Petraglia, M. (eds.) (2017). *Human Dispersal and Species Movement: From Prehistory to the Present*, Cambridge University Press, Cambridge.

Cannon, A., and Burchell, M. (2017). Reconciling oxygen isotope slerochronology with interpretations of millennia of seasonal shellfish collection on the Pacific Northwest Coast. *Quaternary International* **427:** 184–191.

Cariou, E., Baltzer, A., Leparoux, D., Ledoyen, J., and Debaine, F. (2018). Ground penetrating radar in the medieval oyster shell middens of Saint-Michel-en-l'Herm (Vendée, France). *Journal of Archaeological Science: Reports* **18**: 186–196.

Carter, K., and Cannon, A. (2018). Phosphate as an indicator of occupational intensity at shell midden sites on the central coast of British Columbia. *Journal of Archaeological Science: Reports* **20:** 468–475.

Cochrane, E. E., Reith, T. M., and Filimoehala, D. (2021). The first quantitative assessment of radiocarbon chronologies of initial pottery in Island Southeast Asia supports multi-directional Neolithic dispersal. *PLoS One* **16(6)**: e0251407. https://doi.org/10.1371/journal.pone.0251407

Cook Hale, J., and Garrison, E. G. (2019). Climate change, cultural adaptations, and lower coastal plain occupations of Georgia and Florida from the early to middle Holocene: Extrapolating spatial trends into the offshore. *Journal of Anthropological Archaeology* **55**: 101071.

Crowell, A., and Arimitsu, M. (2023). Climate change and pulse migration: Intermittent Chugach Inuit occupation of glacial fiords on the Kenai Coast, Alaska. *Frontiers in Environmental Archaeology* **2**. https://doi.org/10.3389/fearc.2023.1145220

Duke, C. T., Pluckhahn, T. J., and Compton, J. M. (2020). Intensification revisited: Assessing resource specialization at Crystal River (8CI1) and Roberts Island (8CI41), Florida. *Southeastern Archaeology* **39**: 198–217.

Erlandson, J. M., Gill, K. M., Gusick, A. E., and Dorrler, A. (2019). Identifying shell middens with historic aerial photos: An example from California's Santa Cruz Island. *Journal of Island and Coastal Archaeology* **14**: 113–122.

Faulkner, P., Harris, M., Haji, O., Ali, A. K., Crowther, A., Shipton, C., Horton, M. C., and Boivin, N. L. (2019). Long-term trends in terrestrial and marine invertebrate exploitation on the eastern African Coast: Insights from Kuumbi Cave, Zanzibar. *Journal of Island and Coastal Archaeology* **14**: 479–514.

Fernández, L., Ruiz, F., Gómez, G., Muñoz, J. M., Rodríguez Vidal, J., Cáceres, L. M., et al. (2023). Mollusc collection and Holocene palaeogeographical evolution in a southwestern Iberian estuary: Statistical analysis of the early Holocene Cañada Honda shell midden (SW Spain). *Quaternary International* **658:** 24–35.

Gaffney, D. (2021). Pleistocene water crossings and adaptive flexibility within the *Homo* genus. *Journal of Archaeological Research* **29**: 255–326.

García-Escárzga, A., and Gutiérrez-Zugasti, I. (2021). The role of shellfish in human subsistence during the Mesolithic of Atlantic Europe: An approach from meat yield estimations. *Quaternary International* **584**: 9–19.

Gravel-Miguel, C., De Vynck, J., Wren, C. D., Murray, J. K., and Marean, C. W. (2022). Were prehistoric coastal sites more intensively occupied than inland sites? Using an agent-based model to understand the intensity of prehistoric coastal occupation, and what it means for studies on the evolution of the coastal adaptation. *Quaternary International* **638–639**: 148–158.

Gusick, A. E., Dodds, T., Jaffke, D., Meniketti, M., and Ball, D. (2019). Defining maritime cultural landscapes in California. *California Archaeology* **11**: 139–164.

Haour, A., Coulson, I., N'Dah, D., and Labiyi, N. (2022). A coastal occupation in Bénin, West Africa: Earthenwares and salt at the time of Atlantic entanglement. *Journal of Island and Coastal Archaeology*. DOI: https://doi.org/10.1080/15564894.2022.2084654

Hofman, D. L., Angelucci, D., Villaverde, V., Zapata, and Zilhão, J. (2018b). Symbolic use of marine shells and mineral pigments by Iberian Neandertals 115,000 years ago. *Science Advances* **4. DOI:** https://doi.org/10.1126/sciadv.aar5255

Jackson, K., Southard, E., O'Donnell, S., and Arthur, J. (2018). Estimating crown conch (*Melongena corona*) tissue weight from archaeological shell measurements: An allometric methodology for coastal historical ecological research. *Journal of Archaeological Science: Reports* **21**: 107–116.

Jerardino, A. (2021). Coastal foraging and transgressive sea levels during the terminal Pleistocene: Insights from the central west coast of South Africa. *Journal of Anthropological Archaeology* **64**: 101351.

Kirakosian, K. (2015). Mapping the social worlds of shell midden archaeology in Massachusetts. *Bulletin of the History of Archaeology* **25 (2)**: 6.

Kirch, P. V., and Yen, D. E. (2022). Irrigation, fortification, and the proto-historic settlement landscape of the Ndughore Valley, Kolombangara, Western Solomon Islands. *Archaeology of Oceania* **57:** 127–145.
Klokler, D. (2020). Fishing for 'lucky stones": Symbolic uses of otoliths in Brazilian shell sites. *Journal of Anthropological Archaeology* **58:** 101167.
Klokler, D., Ozorio de Almeida, F., Bowser, B., Botelho, E., and Bava de Camargo, P. (2021). The impacts of coastal dynamics on the Saco de Pedra shell midden in northeast Brazil. *Quaternary International* **584:** 93–105.
Kurzawska, A., Apolinarska, K, Silska, P., Sobkowiak-Tabaka, I., and Rennwanz, J. (2021). Garbage, storage or a mussel oven? A case study of a shell midden from western Poland. *Environmental Archaeology*. DOI: https://doi.org/10.1080/14614103.2021.1963161
Kyriacou, K., Parkington, J. E., Will, M., Kandel, A. W., and Conrad, N. J. (2015). Middle and Later Stone Age shellfish exploitation strategies and coastal foraging at Hoedjiespunt and Lynch Point, Saldanha Bay, South Africa. *Journal of Archaeological Science* **57**: 197–206.
Lidour, K., Béarez, P., Beech, M., Charpentier, V., and Méry, S. (2023). Intensive exploitation of marine crabs and sea urchins during the Middle Holocene in the eastern Arabian Peninsula offers new perspectives on ancient maritime adaptations. *Journal of Island and Coastal Archaeology.* DOI: https://doi.org/10.1080/15564894.2021.1962437
Lotze, H. K., Mellon, S., Coyne, J., Betts, M., Burchell, M., Fennel, K., et al. (2022). Long-term ocean and resource dynamics in a hotspot of climate change. *Facets* **7**: 1142–1184.
Mannino, M. A. (2020). Invertebrate zooarchaeology. In Britton, K., and Richards, M. (eds.), *Archaeological Science: An Introduction*, Cambridge University Press, New York, pp. 233–275.
Marrast, A., Béarez, P., Badel, E., and Marcucci, L. G. (2021). Inshore or offshore? The Neolithic fishermen of Ra's al-Hamra (RH-6, RH-5, Muscat, Sultanate of Oman). *Journal of Island and Coastal Archaeology*. DOI: https://doi.org/10.1080/15564894.2021.1974612
Martindale, A., Letham, B., Supernant, K., Brown, T. J., Edinborough, K., Duelks, J., and Ames, K. (2017). Urbanism in northern Tsimshian archaeology. *Hunter Gatherer Research* **3**: 133–163.
Milano, S., Schöne, B. R., González-Morales, M. R., and Gutiérrez-Morales, I. (2022). Temporal and spatial variability of prehistoric aquatic resource procurement: A case study from Mesolithic northern Iberia. *Scientific Reports* **12**: 3111.https://doi.org/10.1038/s41598-022-07239-8
Miszaniec, J. I., Darwent, J., and Darwent, C. (2021). Small game, estuaries, and nets: New perspectives on Norton culture coastal adaptations from a shell midden in Norton Sound, Alaska. *Journal of Island and Coastal Archaeology* **16:** 317–341.
Morrison, A., and Allen, M. (2017). Agent-based modelling, molluscan population dynamics, and archaeomalacology. *Quaternary International* **427**: 170–183.
Napora, K. G., Bonsall, J., Rathbone, S., and Thompson, V. D. (2019). Geoarchaeological analysis of a dunefield shell midden site in Carrowdough Townland, County Sligo, Ireland. *Journal of Island and Coastal Archaeology* **14**: 394–410.
Nunn, P. D., Ward, I., Stéphan, P., McCallum, A., Gehrels, W. R., Carey, G., et al. (2022). Human observations of late Quaternary coastal change: Examples from Australia, Europe and the Pacific Islands. *Quaternary International* **638–639**: 212–224.
Parker, W. G., Yanes, Y., Mesa Hernández, E., Hernández Marrero, J. C., Pais, J., and Surge, D. (2020). Scale of time-averaging in archaeological shell middens from the Canary Islands. *The Holocene* **30**: 258–271.
Pearson, G. A., Martín, J. G., Castro, S. A., Acosta, M. J., and Cooke, R. G. (2021). The mid Holocene occupation of the Pearl Islands: A case of unusual insular adaptations on the Pacific Coast of Panama. *Quaternary International* **578**: 155–169.
Prieto, G. (2023). Shark fisheries during the second millennium BC in Gramalote, north coast of Peru. *Journal of Island and Coastal Archaeology* **18**: 165–195.
Prieto, G., and Sandweiss, D. H. (eds.) (2020). *Maritime Communities of the Ancient Andes*, University Press of Florida, Gainesville.
Sassaman, K. E., Steffy, C. A., Shanefield, S. C., Mahar, G. J., and Slapcinsky, J. D. (2023). Terrestrial snails from archaeological sites as proxies for relative sea level on the Gulf Coast of Florida, USA. *Journal of Island and Coastal Archaeology*. DOI: https://doi.org/10.1080/15564894.2022.2131943
Singleton Hyde, H. M., and Wallis, N. J. (2022). Coastal subsistence and platform mound feasting on Florida's northern Gulf Coast. *Journal of Island and Coastal Archaeology* **17**: 375–401.

Toso, A., Hallingstad, E., McGrath, K., Fossile, T., Conlan, C., Ferreira, J., et al. (2021). Fishing intensification as response to Late Holocene socio-ecological instability in southeastern South America. *Scientific Reports* **11**: 23506.

Veth, P., McDonald, J., Ward, I., O'Leary, M., Beckett, E., Benjamin, J., et al. (2020). A strategy for assessing continuity in terrestrial and maritime landscapes from Murujuga (Dampier Archipelago), North West Shelf, Australia. *Journal of Island and Coastal Archaeology* **15**: 477–503.

Wallis, N. J., LeFebvre, M., Blessing, M. E., and McFadden, P. (2022). Exploring the origins of coastal villages: New discoveries at the Spring Warrior civic-ceremonial center on Florida's Gulf Coast. *Journal of Island and Coastal Archaeology.* DOI: https://doi.org/10.1080/15564894.2022.2135650

Weinberg, C., Osborn, J., and Espino Huaman, R. (2022). Marine shellfish exploitation as a means of reducing vulnerability to resource uncertainty in southern coastal Peru (200 BCE–150 CE). *The Holocene* **32**: 1503–1517.

Weisler, M. I., and Rogers, A. J. (2021). Ritual use of limpets in late Hawaiian prehistory. *Journal of Field Archaeology* **46**: 52–61.

Wolverton, S., Figueroa, R. M., and Armstrong, C. G. (2023). Integrating historical ecology and environmental justice. *Journal of Ethnobiology* **43:** 57–68.

Zangrando, A. F. J., Tivoli, A. M., Alunni, D. V., Pérez, S. A., Paz Martinoli, M., and Pinto Vargas, G. (2021). Exploring shell midden formation through tapho-chronometric tools: A case study from Beagle Channel, Argentina. *Quaternary International* **584**: 33–43.