Maritime cultural landscapes and maritime communities
The contribution of logboats to understanding our past: evidence from Lough Corrib, Ireland

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Abstract: The study of boats is integral to understanding how societies lived and moved on and around lakes and rivers throughout time. This paper discusses the discovery and investigation of a number of newly discovered logboats from Lough Corrib. These are greatly adding to our knowledge in this area and providing new and exciting insights into the use of boats in the inland waterways, as well as providing a greater understanding of the wider lacustrine cultural landscape. This chapter provides an overview of work carried out by the Underwater Archaeology Unit of the National Monuments Service investigating over 30 logboats dating from the Neolithic to Mediaeval times. An overview of how these discoveries are enhancing our knowledge of the wide range of social practices taking place on the lake including raiding, hunting, warfare, travel and communication is presented. Particular focus is applied to a number of logboats which can be argued to have been deliberately sunk as part of ritual deposition.

Introduction

It is not surprising that, as an island subject to a damp, temperate climate and influenced by a seemingly never-ending cycle of Atlantic weather systems, large areas of the Irish landscape are dominated and delineated by water in the form of numerous rivers, lakes, bogs and streams. This network of waterways and wetlands has not only shaped and moulded the landscape, but also strongly influenced settlement patterns, land use, political developments and social practices, while also influencing the shape of ancient tribal and territorial divisions which still form the basis of many of the administrative boundaries today.

In recent centuries, the drainage of these waterways has resulted in the discovery of thousands of important artefacts, many of which now make up a large parts of the significant collections in the National Museum of Ireland in Dublin, the Ulster Museum in Belfast and many smaller designated museums around the country. Logboats form an important part of these collections, with over 560 recorded to date throughout Ireland (MacDowell 1983; Gregory 1997; Fry 2000; Wreck Inventory of Ireland Database (WIID)). Unfortunately, many of the boats found in earlier times were destroyed, broken up for fire wood, reused for farm buildings or removed from their anaerobic environment and left to dry out, resulting in their rapid deterioration and ultimate destruction. As a result, very little information is known about the early finds. Very often, these older finds were made when lake levels dropped in the summer months and the logboats were identified close to shore, having probably been exposed time and again over the centuries. The identification of logboats in deeper lake and river waters in recent times has created the possibility for developing a better understanding of the nature and significance of these vessels.

In Ireland, logboats have traditionally been considered simple or crudely made vessels with very little to contribute to mainstream archaeology and seen to be of interest only to early watercraft specialists. This has led to mainstream archaeology largely ignoring these finds, with only occasional passing mention in the principal archaeological textbooks. In recent years, however, this narrative has changed somewhat as result of targeted research and interventions by heritage authorities to record, research and at times save logboats under threat of being damaged or destroyed. In this regard, archaeological investigations carried out by the Underwater Archaeology Unit of the National Monuments Service in Lough Corrib have resulted in a remarkable range of finds being revealed, not only ancient logboats, but also the artefacts associated with the wrecks themselves (Brady 2014: 34–38, 2015: 20–21). These finds have begun to highlight the value and importance of such watercraft by providing new insights into how early watercraft changed and developed over time, while also highlighting the importance of such craft in their own right. Additionally, the role boats played in the domestic, industrial, social, ritual and martial lives of the past societies who lived and moved on and around the lake over several millennia is becoming clearer, thereby also highlighting the rich archaeological potential of our inland waterways, and lakes in particular.

Lough Corrib Location and historical background

Lough Corrib is located in County Galway in the west of Ireland. It is the second largest lake on the island of Ireland with a surface area of approximately 176 km². It is an irregularly shaped lake which measures 44k m in length by 17 km at its widest, but it narrows to only 600 m near its central point. It is a relatively shallow lake dotted with well over 1,000 islands and islets. The Lough is generally...
considered to have depths generally not exceeding 10 m; however, there are areas of deeper water at the northern end of the lake which reach 50 m plus. The lake has lots of folkloric associations, with its origin story probably being the best known.

The name Corrib is thought to be a corruption of Orbsen or Oirbsen, which is another name for Manannán Mac Lir, the mythical mariner who ruled the other world (Ó hÓgáin 1990: 286–289). Manannán has many watery associations, including being god of the sea (mac Lir literally meaning ‘son of the sea’) with a boat called Wave Sweeper in which he could travel over land and water (Kelly 2019: 34–41). Kelly has also suggested Manannán was protector of the solar boat on its nightly journey through the Underworld and should be regarded more as a solar deity than a sea god (Kelly 2019). In Irish tradition, Manannán was reputedly killed at the legendary battle of Moycullen (located on the west side of the lake), and when his grave was being dug, a great torrent of water poured from the hole to form the lake now called Lough Corrib. Given Manannán Mac Lir’s association with the origin-legend of the lake and boats, it is not unreasonable to put forwards the possibility that some of the boats, which were ritually deposited in the lake (see below) may have been dedications or votive offerings to Mac Lir himself.

The earliest representation in the literary sources of the Lough Corrib area may come from Ptolemy’s second-century AD Geography or Atlas, which provides a list of places, tribes and co-ordinates for the known world including Ireland. Orpen has suggested that Ausoba may represent Galway Bay or the 6 km-long River Corrib, which drains Lough Corrib and the wider area (Orpen 1894: 118). Ptolemy lists a tribe in the area known as the Auteini, which would indicate that in the later Iron Age, the area was one of a handful of locations known to merchants and mariners travelling along the Atlantic fringes important enough to be mentioned in Ptolemy’s map and Geography. As some of the logboats investigated so far date to this period, it is tempting to think we can associate these boats with a named Iron Age tribal group for which we have no other literary evidence. Over time, the lake was an important defining boundary between the surrounding ancient tribal territories, which by later Mediaeval times became the baronial districts which are extant today.

Background to the logboat discoveries and follow-up investigations by the Underwater Archaeology Unit

The logboats came to light during hydrographic surveys of the lake undertaken by Trevor Northage, a master mariner.
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who mapped the lake from 2008–2014 in order to produce navigation charts for recreational use (Northage 2014). In addition to the detailed charts produced of the lake, sidescan sonar data collected during the survey has revealed and imaged important new information regarding the bathymetry, geology, ecology and make-up of the lakebed, as well as imaging a large number of previously unrecorded logboats and wreck sites. As part of its wider statutory brief to manage and regulate activity on underwater archaeological sites in Ireland, including the inspection of new discoveries, the Underwater Archaeology Unit (UAU) of the National Monuments Service (NMS) liaised with Mr Northage on his discoveries, following his reporting of new finds to NMS. The UAU then began to undertake its own surveys of the lake, as it clearly retained further extensive and significant underwater cultural heritage. Since 2012, the UAU has been carrying out a systematic programme of surveys and investigation in Lough Corrib identifying, documenting and analysing these sites, while also recording them in the WIID.

During the course of our work, a number of threats to these sites have been identified, highlighting the need for more proactive investigation and rescue work to ensure that some of the more fragile, vulnerable and archaeologically significant sites are protected. This has led to a number of important artefacts being recovered from the lake to ensure their long-term protection. The threats to these sites vary and include unregulated diving activity on a number of logboats (all diving on archaeological wrecks over 100 years old requires a licence issued by NMS), accidental damage as a result of anchoring by boating traffic and increased storm activity as a result of climate change, an issue which is only going to increase with time (Daly 2019; Harkin et al. 2019). Damage as a result of the spread of invasive species to the waterway such as Dreissena polymorpha (zebra mussels) and Lagarosiphon major (curly waterweed) are also identifiable threats.

In addition to the anthropogenic threats, the normal range of erosive and biological forces are also evident in the lake, with wood borers and chironomoid larvae degrading the boats over time and destroying important evidence such as original features and tool marks. To date, over 60 potential sites have been dived and investigated by the UAU, of which 30 have been confirmed to be ancient logboats, with a further four sites being confirmed as wooden lake boats dating to between the eighteenth and twentieth centuries. There are a further 15 potential logboat sites and geophysical anomalies still to be investigated, and when combined with the previously documented historic finds, there are potentially 53 logboat

Figure 1.2. Distribution of known logboats at Kilbeg and Knockferry represented by the yellow dots. Known archaeological monuments on land are represented by red dots. Ordnance Survey Ireland License No OSI-NMA-014, reproduced courtesy of Tailte Éireann, Government of Ireland.
sites located in the lake, with the possibility that many more will be discovered.

**Ferrying point**

Most of the boats identified during the hydrographic surveys are located within a 6 km stretch of the central part of the lake where the waters are shallowest and the lake is narrowest. Mr Northage focussed his surveys primarily in this area. The number of logboats now known from here, as identified during the surveys, may indicate a certain bias in the strength of the concentrations recorded, but this may be explained by the intensity of survey specific to that stretch of water. There may certainly be similar concentrations elsewhere awaiting discovery. This middle section of lake, however, is also the narrowest part of the waterway through which all traffic travelling from the lower lake to the upper lake must pass. It is also a known ferry point between Knockferry and Kilbeg, which would have served to link the ancient tribal and political boundaries on either side of the lake. This narrow stretch of water would have provided a more sheltered and therefore safer crossing point than the wider and exposed expanses of water to the north and south, which can become extremely choppy and difficult to navigate during any sort of windy weather. It is therefore not surprising that a number of ferrying points were used during the nineteenth and twentieth centuries in this area, as was also the case in earlier times, at different locations (Spellissy 1999: 258, 420).

The concentration of 16 logboats all within 1 km of each other and all within 600 m of the Knockferry/Kilbeg crossing point only serves to confirm that this area was an important ferrying point from at least the Middle Bronze Age onwards. Many of the logboats found here would have been eminently suitable as ferries, such as the 10 m-long Late Bronze Age Kilbeg logboat dating to the tenth century BC. Its spacious floor would have been ideally suited for carrying people, animals or cargo. Equally so, the 10.25 m-long oak logboat (Kilbeg 3), which is subdivided into four sections by three low transverse ridges, could have performed a similar function (see Figures 1.1 and 1.4). Apart from serving as a crossing point, this area would also have been an important waterway through which all north-south traffic travelled and, therefore, an important location from a strategic point of view, where movement of boats, people and goods could more easily be monitored and controlled.

The logboats investigated by the UAU thus far have a date range from the middle Neolithic to the sixteenth century AD. As would be expected with a collection of boats spanning such a long time period (5,000 years), they vary in size, style, construction, complexity, function and level of preservation. The earliest boat, the Callownamuck logboat, is the longest logboat found in the lake, measuring 15.67 m. Unusually from an Irish perspective, the Callownamuck logboat was fashioned from a pine tree. In Ireland, the majority of boats are constructed using oak, with only 1% of Irish examples constructed from other species such as alder or poplar (Gregory 1997: 162–163; Holtzman 2019).

**Evidence for communication, transfer of ideas and technological advancement**

The broad range of logboat types are providing evidence for communication, technological advancement in boat construction and design over time, including the introduction of new repair techniques in line with technological advances which were taking place in Britain and on the Continent at the same time. For example, the floor of the poorly preserved Lee’s Island logboat had developed a split along its centreline for over half its length; it was subsequently repaired using the same techniques used to build the Bronze Age plank-built boats known from England and Wales (see Wright 1990; Clark 2004 for example). The split was sealed using moss caulking covered by a longitudinal lath which was lashed in place using withies. A number of wooden cleats were inserted into the floor of the boat, through which rods were inserted to help stabilise the split sides of the logboat and provide structural strength. The Lee’s Island boat has been dated to 3023 ± 27 BP (1390–1134 cal BC, 2-sigma) and, whilst it is still a logboat, the use of similar sewn plank boat technology to repair the splits provides the earliest evidence for the existence of such technology in Ireland during this period. The emerging evidence for the wider use of plank built boats outside of Britain is also being highlighted (Crumlin-Pedersen and Trakadas 2003; Kastholm 2015; Wickler 2019), with a number of Bronze Age and Iron Age examples from Denmark and Norway now identified. Consequently, the plank boat technology observed in the Lee’s Island logboat can also be viewed as an ‘indicator of a broader interregional tradition of plank-building in Western Europe’ as noted by Kastholm (2015: 1369). Nevertheless, this raises an intriguing question: if sewn plank boat building techniques were known, why did they not supersede logboats? It is possible that future discoveries will uncover evidence of sewn plank boats being more widely used on the lough and beyond. However, based on current findings, it appears that the logboat remained the preferred and prevailing style of boat in use until Mediaeval times, despite plank boat techniques being known at the time.

Other technological advancements include the introduction and changing style of seats over time and a change in method used to propel the boats. As McGrail (1978: 320) and Gregory (1997: 119–120) have noted, the method used to propel a boat can leave very little evidence, and rowing can be particularly hard to detect, unless features such as footrests, thwarts, oars and thole pins are preserved. In the absence of these features, it can only be assumed all other logboats were propelled by paddling. There is no evidence for the use of seats in the Neolithic or Bronze Age logboats so far discovered in Lough Corrib, and it is likely that paddling was the main method of propulsion for these vessels. Two of the Iron Age vessels have seats but are presumed to have been paddled in the absence of any
direct evidence for rowing. For example, the Lee’s Island 5 logboat (circa 200 BC) had two seats, which were made by inserting 7 cm-wide roundwood poles into the sidewalls of the boat near either end to form seats 5 cm below the top edge (see Figures 1.5 and 1.6). The Clydagh logboat, which is of a similar date, had at least three sets of parallel rectangular slots on its top edge for receiving three narrow flat plank seats; the vessel originally could have had more, but further investigation is required to confirm this. In the Mediaeval period, there is evidence for further development with Lee’s Island 3 logboat, the Illuaconoanaum 1 logboat and the Carrowmoreknock logboat (see Figure 1.3), all constructed with footrests, oarlocks and plank seats which give direct Irish evidence that by the fifth century AD, rowing had become a common method for propelling vessels on the lough. The Carrowmoreknock logboat also contained the remains of the fragments of two oar handles. Rowing was certainly in use in Ireland by the first century BC with the exquisite gold model known as the Broighter boat, now on display in the National Museum of Ireland, having 15 oars represented and providing representative evidence for this method of propulsion for vessels. It is likely that some of the Iron Age vessels from Lough Corrib were rowed, but evidence has not survived due to the poor preservation of some of the boats from this period.

Logboat size, availability of suitable trees, and depletion of forests

Over time, the boats become more refined: lighter in construction with thinner walls and floors indicating technological advancement in boat construction techniques due to the use of better tools and the development of a better understanding of the basic principles of hydrostatics and hydrodynamics. In tandem with this, there is a general trend for the logboats to decrease in size over time; the Neolithic boat is the longest, measuring 15.79 m in length. The Bronze Age logboats, while still impressively large vessels, are slightly smaller in overall size, ranging from 13.00 m to 6.20 m in length (Lee’s Island 2 logboat has a surviving length of 6.20 m, but its original length would have been at least 1 m longer, based on its current dimensions). Overall, the Iron Age logboats are slightly smaller again and range from 11.3 m to 7.54 m in length. There is a notable reduction in the size of Mediaeval vessels, with all five examples investigated by the UAU being less than 6.50 m in length. The Carrowmoreknock vessel is the longest, measuring 6.30 m, whereas the one-man canoe from Rinnaknock measures 3.30 m long, although its bow and stern are not intact, and its original size is estimated to have measured just under 4 m. The gradual decrease in size of the logboats over time appears to reflect the gradual decrease in woodland cover, with forests being cleared for cultivation, development of human settlements and as a resource for everyday living, which would have included the building of boats. Continuous forest clearance resulted in younger, smaller trees being cut down and used before they had a chance to grow large enough to be fashioned into large-sized boats, which were more common in earlier times.

This depletion of woodland in the area is also reflected in the pollen evidence taken from a core from Mám Éan (Maumeen), a corrie lake located approximately 8 km to the west of Lough Corrib (O’Connell 2021). The pollen evidence shows that there was a major reduction in woodland cover from the Neolithic onwards, stemming from the increased farming which continued throughout the Bronze Age and Iron Age. By the end of the twelfth century AD, the surrounding landscape has been largely depleted of forests. The pollen evidence indicates a near total collapse of oak coverage around 1200 AD (O’Connell 2021), which may explain why, out of the 50 plus logboats currently known from Lough Corrib, only one logboat dates to the thirteenth century or later. There were simply very few oak trees of suitable size left to make the logboats, and it is possible there was a switch to the use of skin boats on the lake at this stage. Skin boats or currachs/coracles required far less wood and were made using hazel rods (still growing in the area at the time) and ox hides. A vessel of this nature from this period has yet to be found, but their widespread use from prehistoric times onwards in Ireland has been well documented in the sources (O’Donovan 1856; Breen and Forsythe 2007). However, this is not to say large logboats were not being made in later times in Ireland, but evidence to date from Lough Corrib would suggest they were largely absent from the lake area. However, there are examples from other parts of the country, including the 13.72 m-long Mediaeval logboat from Bartins Bay, Lough Neagh, which is estimated originally to have been over 15 m in total length, being a rare example of an extremely long Mediaeval vessel (Fry 2000: 60–61).

Evidence for raiding and warfare

Also reflected in the logboat discoveries and their contents are other activities that were taking place on the lake. The discovery of a range of weapons in the boats, such as iron, bronze and wooden spears and iron axes, are providing valuable insights into how these weapons were possibly used for raiding, hunting, warfare and for protection (Brady 2014, 2015). In this regard, the Carrowmorenock logboat is probably the finest Irish example of a boat built as a war canoe during the Viking period, a turbulent time in Ireland with Irish and Vikings vying against each other for power. The 6.3 m-long canoe-shaped logboat is well-designed, finely crafted, built for speed and virtually intact, providing rare evidence for a high-status vessel dating to the eleventh/early twelfth centuries AD. The boat has a rounded transverse section, a rounded stern in all three planes and a bow which terminates in a rounded-point. The boat originally had five thwarts/seats made from willow, with one located at the stern comprised of a short, narrow, thin willow board which slotted into recesses on either side of the boat and was used by the helmsman or steersman or possibly even by a passenger. There are positions to accommodate additional seats, as indicated by four pairs of thwart rests, which survive as blocks, carved in the solid that project out from the internal sides of the boat and which supported the seat. These thwart rests are
regularly spaced along the main body of the boat, with three of the plank seats found in place. The remains of two thole pin holes (sockets in the gunwale to receive a pin, which projects upwards to provide a pivot for an oar) also survive on the top edge, although there originally would have been four sets of corresponding thole pin holes. The presence of seats, thole pin holes and two fragments of ash oars illustrate clearly that this boat was rowed, rather than paddled. Within the boat, some of the original contents and belongings of the crew were also found, including three Viking style battle-axes with attached cherry wood handles, an ironwork axe, two iron spear heads, a fossil rich stone and a carved red sandstone slab. The red sandstone slab has the appearance of a rough out for a grave slab, or perhaps it was planned to be used as a decorative or architectural feature on a stone church. If this is the case, it is probable that the slab was being transported to one of the nearby ecclesiastical sites, like Inchagoill, which are located on islands within the lake when the vessel sank.

The boat likely belonged to a high-status individual, such as an important ecclesiastical figure, one of the ruling elite or a local chieftain with his warrior crew. They may perhaps have been escorting him across the lake on tribal business, such as gifting a carved stone slab to one of the local churches or engaging with rival ruling chieftains and thus bringing gifts to support dialogue. While the boat may have sunk while transporting the red sandstone slab, it is evident from the vessel’s overall design and the presence of weapons on board, it was not primarily intended for everyday transportation, ferrying or fishing. Instead, this boat displays characteristics more akin to a war canoe or raiding vessel, suggesting its purpose was to serve as a means of maritime warfare. Manned by a crew of five well-equipped warriors, it provided the ability to traverse the Lough swiftly and patrol boat movements, exercise political control or engage in raids. Such maritime activities, including numerous attacks, raids and naval encounters, are frequently documented in Irish historical annals (O’Donovan 1856; Freeman 1944). While Viking fleets in the ninth and tenth centuries raided inland from the coast using the river Corrib to access Lough Corrib and further beyond, by the eleventh and twelfth centuries Gaelic Irish families like the O’Flaherty’s and the O’Connors were in control of the lake and had their own fleets of boats and were well able to defend their territory as a result. Subsequently, the Norman de Burgos who established a base in Galway also sought to control activity on the lake (O’Donovan 1856; Freeman 1944).

Figure 1.3. View of a diver hovering over the 6.30 m long Carrowmoreknock logboat, which is viewed from the bow end. Four of the five thwarts/seats (only three visible in the photo) were still fixed in their original positions when the boat was excavated. Photo by Connie Kelleher, copyright National Monuments Service, Government of Ireland.

Accidental loss, deliberate deposition, or killing of boats?

A regular question which arises in regard to the logboats is why did they sink? Undoubtedly, most can be deemed to be accidental losses, but there are a number of logboats from the lake for which it can be argued they may have been deliberately sunk as part of ritual deposition. The Lee’s Island 5 logboat, along with its contents, is probably the most convincing example of deliberate sinking. It may have been scuttled as a votive offering, possibly to appease a deity, or as a boat burial; the latter is discussed below. It can be argued that other boats too from Lough Corrib were ritually deposited, while others could have been deliberately sunk for other reasons, including the deposition of spoils of war or war-booty or even ritualistic ‘killing’ of boats.

Both Van de Noort (2011: 217–221) and Prior (2004: 32) have suggested that there is good evidence in Britain during the Bronze Age and Iron Age for the practice of ritually killing boats. Prior (2004: 32) has argued that one way to ‘ritually destroy a boat is to sink it’, and that the Hanson logboat found in a gravel pit in Shardlow (Nottinghamshire) dating to c. 1500 BC with a cargo of sandstone blocks was a deliberate deposition. The Iron Age logboat found at Fiskerton also appears to be a ritual deposition, being fastened to the riverbed using wooden posts (Field et al. 2003: 24; Prior 2004: 32; Van de Noort 2011: 217–221; Markoulaki 2011: 114–118), and therefore considered also to represent a ritually ‘killed’ vessel. Clark (2004: 279) has suggested the Brigg Raft was ritually ‘killed’ after a post was driven through a hole in the boat’s
floor, fixing it to the riverbed and thus preventing it from doing what it should do, which is move in water. Champion (2004) has hypothesised that a number of the British sewn plank boats were connected to ritual deposition while also arguing that the Dover Boat was deliberately partially dismantled and abandoned as part of ritual killing in tidal waters of the River Dour at Dover.

When the Clydagh 2 logboat was discovered, it was initially thought this logboat may have been deposited on the lakebed as part of a prehistoric ritual deposition. This logboat is unusual in that it was deliberately cut into two sections which now lie 3 m apart and perpendicular to each other on the lake bed in 6 m of water. One section is orientated east to west, is 3.56 m long with a 47 cm-wide stern, and is 66 cm wide at its broken/open end. The second section lies 3 m to the south but is orientated north to south, with its open end facing away from section one. It is similar in size to section one, being 3.50 m long, 45 cm wide at its complete end, and 62 cm wide at its broken/open end. The original logboat was carved from oak, rectangular on all three planes and roughly finished. It is possible too that it was unfinished, given the rough surface and regularity of overcuts and tool marks visible on the logboat. The deliberate cutting of the boat into two halves near its midpoint is evidenced by tool marks at the severed edges of both ends as a result of the cutting process. As the width of the two broken ends do not match exactly, there being a 4 cm-difference in width, it is clear that a small middle section of the logboat was lost when the boat was cut in two.

The logboat’s location, almost centrally placed in Clydagh Bay, over 430 m from the nearest shoreline, indicates that the two parts of this vessel did not accidentally drift from the shoreline to this location. Instead, the logboat was cut carefully into two on the lakeshore and then floated out to a central location; this must have been pre-planned and would have taken a significant amount of effort. The two parts were then deliberately and carefully submerged on the lakebed in close proximity to each other. The initial interpretation for this act, when the logboat was first discovered by the UAU, was that it was deposited as a part of ritual activity, possibly in the Bronze Age. Champion (2004) suggests that when the British Bronze Age sewn plank boats were dismantled and deposited, they were being deliberately decommissioned, rendered useless and therefore ritually or symbolically ‘killed’. It appeared this theory could apply to the Clydagh 2 logboat. However, recently obtained radio carbon dates of each end of the boat have revealed that the logboat is not Bronze Age in date, as initially believed, but rather, hails from the ninth or tenth centuries AD. This new information makes it is highly unlikely the boat was destroyed as part of a ritual act. Instead, a more plausible explanation would appear to be it was destroyed during or after a military engagement. As mentioned earlier, naval battles were common on the lake, and the Viking raids on Lough Corrib in 927 and 928 AD (O’Donovan 1856; Freeman 1944), for instance, could have led to the destruction of an enemy’s boat by either side in an attempt to reduce their adversary’s naval power and influence.

Stone laden logboats

This author suggests three logboats from Lough Corrib provide evidence of being symbolically or ritually ‘killed’. A number of boats from Lough Corrib carried stones of varying sizes, but three contained large cargos of limestone blocks, including Kilbeg 3, Kilbeg 5 and Kilbeg 9. These three boats date to the mid-late Bronze Age, with Kilbeg 3 dating to 1202–1008 cal BC, Kilbeg 5 dating to 1415–1233 cal BC and Kilbeg 9 having a similar date of 1419–1280 cal BC. Kilbeg 3 is a 9.90 m-long oak logboat with five transverse low ridges creating six separate spaces in the boat, with the cargo of stone mainly concentrated in the middle two sections. The stones appear to have been carefully placed in the boat, lying on a thick layer of moss to prevent damage to the boat. A few random stones have scattered towards the stern, and a few loose stones appear to have fallen outside the boat. Kilbeg 5 is poorly preserved and smaller in size, measuring 6.80 m in length with just its floor surviving. Nine small stones and a larger boulder are located at the vessel’s stern, and there appear to be patches of clay or degraded limestone cobbles spread along the floor of the boat to its mid-way point; its forward end is largely devoid of stone. Kilbeg 9 is also poorly preserved, with just its 9.20 m-long floor surviving, although broken in several places. This vessel carried two piles of stone, a group of three large boulders at the stern, a smaller pile of ten stones at the bow and a scattering of stones also in the midship area of the boat.

It is possible there is a more prosaic explanation for the cause of sinking of these boats. One such scenario is they may have been inadvertently lost while navigating the lake due to the heavy loads of stone they were carrying. It is not unreasonable to consider these vessels could have become destabilised and swamped during bad weather, resulting in their ultimate demise on the lakebed. However, considering the close proximity of the three boats in a sheltered and relatively calm section of the lough, this explanation seems unlikely. There are other potential scenarios which could have resulted in them becoming submerged on the lakebed, including deliberate sinking. The wet storing of logboats to prevent them from drying out must be considered, and in 1966, Kunze (1968: 168–169) documented the wet storing of a logboat in Lake Mondsee, Austria. The boat was submerged in 2 m of water so that its upper edge was at least 1 m underwater. The boat was weighted and held down using stone and long poles to prevent the boat moving. Kunze also noted that this practice was also being carried out in the nineteenth century too. According to Kunze, the storing of the boat under water prevented the boat from drying out and cracking, increased its durability while also preventing splinters which could catch nets developing on the floor of the boat. The practice is still used today, with a team at the Kuratorium Pahlbauten successfully wet storing a replica Bronze Age logboat underwater for an 11-year period before it was lifted to participate in a logboat race in 2016 (Cyril Dworsky, personal communication). Whether this practice was used in more ancient times, we do not...
know, and so far there is no evidence for this in Ireland from any period.

Arguments against these theories applying to the three Kilbeg logboats is that they are all currently submerged in 6 m of water, and lake levels were previously 1 m higher prior to drainage works in the mid-nineteenth century. It would have been impossible to remove all the stone and re-float the boats, given the depth of water. A further argument against this is their distance from the shoreline, begging the question as to why, if they were deliberately submerged for practical purposes, were they not submerged closer to shore where they could more easily be retrieved? Locating the boats would have been difficult, given they are all more than 250 m offshore. It is possible lake levels were lower at the time of their sinking, but there is no evidence for this. Additionally, the close proximity of the three boats together would indicate these were boats were not forgotten about after sinking and left on the lakebed, but rather, their deposition was an intentional act, and they were deliberately and permanently deposited on the lakebed. If this is the case, then it seems logical that the boats were deposited as part of ritual deposition. Another consideration is that all three boats were deliberately sunk by being loaded with boulders and stones to help ensure they sank and stayed submerged on the lakebed. Why this was done, we do not know, but maybe when a boat had reached the end of its useful life, it was decided to sink it as a votive offering. It therefore could be argued these boats were put beyond any further meaningful use and were ritually ‘killed’. The possibility they were associated with recently deceased individuals connected with the boat, possibly a drowning, might also be considered as a reason for their deposition.

**War offerings?**

The Rabbit Island logboat is another vessel which might be considered as a votive offering, but this argument is not as convincing as is for some of the other logboats. Only the base of the 8.2 m log oak boat survives, in which four iron spear heads and fragmentary remains of their hafts were found. Along the starboard side near the bow of the logboat lie two loose pieces of wood with a series of circular holes and rectangular recesses positioned along their edges. It is unclear if these pieces of wood represented side planking which has fallen off the boat or the actual side walls had collapsed, and further investigation is required to confirm this. If this is side planking, then this vessel is an extended logboat, and only one of a few examples known in Ireland. The boat has been dated to c. 300 BC.

As highlighted above, the deliberate deposition of vessels in watery environments is well documented on the Continent with the Hjortspring boat (Crumlin-Pedersen and Trakadas 2003) being one of the best known examples. This Iron Age (c. 350 BC) warship was sunk as part of a ritual offering along with its contents, 138 iron spear heads and many other items which are interpreted as a sacrifice of the spoils of a battle or war (Kaul 2003: 141–185). Is it thus possible the Rabbit Island logboat was also a deposition representing spoils of war following a victory, or was perhaps sunk as a votive offering seeking to invoke the favour of a deity in advance of a military
engagement? Such scenarios are extremely difficult to prove, and it may also represent the accidental loss of a vessel carrying a hunting party or a crew just armed for self-defence purposes.

**Ritual deposition of the Lee’s Island 5 logboat**

The Lee’s Island 5 logboat is probably the most convincing and most remarkable example of the ritual deposition of a boat in water, and this is largely due to its high level of preservation, almost perfectly preserved to its top edge. The 7.54 m-long ash boat is parallel sided with a rectangular bow and stern in plan, both of which have inclined profiles. The boat has a maximum width of 70 cm and a maximum internal depth of 34 cm. While most of the logboats from Lough Corrib still have random patches of sapwood remaining in their hull structures, sapwood was generally removed during the construction process, as it is weaker and less durable than heartwood. However, Lee’s Island 5 is unusual in that its top edge is entirely formed of a thick layer of sapwood. Apart from indicating the bole of the parent tree was not much wider than the recorded width of the boat, it also demonstrates that ash trees of a larger size could not be sourced locally. This is supported by the analysis of pollen cores retrieved by O’Connell (2021) from Mám Éan (Maumeen) corrie lake, which confirms deforestation in the wider area. The upper works of the boat would therefore have been weaker and subject to damage, and this possibly explains why the side wall is thicker than most other logboats, being up to 8 cm in places.

The logboat had two seats or thwarts still in place, located 2.30 m and 1.60 m from the stern and bow, respectively. The seats are carved roundwoods measuring 7 cm in diameter. The stern seat was originally integrated into the side walls and held in place through a circular perforation on either side, into which the seat was fixed. The forward seat would originally have also been integrated into the side walls, but this end of the boat is slightly more worn, resulting in erosion of the original circular slots in the sidewalls which held the seat. As seats are located towards either end, a 3.60 m-internal space was left clear in the middle of the boat, which may have accommodated cargo while travelling or carried animals or other travellers/crew. The boat was flat bottomed with two thickness gauge holes, one slightly forward of amidships with its dowel still in place and a second one 40 cm aft of the stern seat with its dowel/plug missing. Another feature of the boat is that it developed a 4 m-long crack at the turn of its bilge on the port side. This is not surprising, as this is one of the thinnest parts of the boat, and a large component of the exterior of the boat is made up of sapwood. Two radiocarbon dates were obtained from the sapwood (754–409 cal BC (2 sigma) UBA–24534) and a cut piece of brushwood (375–171 cal BC (2 sigma) UBA–27785) found in the boat; all dates securely place the logboat in the early Iron Age period.

Much of the boat’s contents survived in situ, including an iron spearhead with a fragment of its wooden haft located under the forward seat. A 2 m-long oar, carved from ash, also formed part of the cargo and was located in the forward half of the boat. The oar’s proportions are important with regard its function, having a blade length matching the handle length and closely resembling the portions of the steering oar from the first-century BC gold model from Broighter, Co. Derry (Farrell et al. 1975). This resemblance suggests that the oar in question could indeed be a steering oar. Furthermore, the oar is significantly oversized for a 7.54 m-long logboat, indicating that it was likely crafted for a larger vessel, further reinforcing its potential role as a steering oar. Integrated into the stern seat was a socketed and looped iron work axe, complete with its wooden haft. Remarkably, it looks as if the axe was purposely fixed to the boat with the intention of making it a permanent feature. In order to do this, a slight recess was carved into the side wall of the boat to accommodate the upper end of the axe handle so it could lean against the recess to help secure it in place. The seat was also lowered to the level of the axe handle, locking it firmly between the logboat floor and seat and against the side wall. In order to lock the axe in place, a semicircular notch was carved out of the

![Figure 1.5. View of 7.54 m long ash logboat, Lee's Island 5, from the bow end. The steering oar and iron spear head are visible under the forward seat.](https://example.com/image1.5)
upper side of the axe handle so that the seat’s round profile would neatly fit into the notch on the handle, ensuring it was locked in place. This rendered the axe redundant as a working tool by making it a permanent part of the boat and critically weakening its handle, resulting in the loss of its structural integrity and strength. The repositioning and lowering of the seat created voids in both sides of the boat near the waterline, which appear not to have been sealed or plugged and would have helped cause the boat to flood.

The reason why they went to such trouble to alter the axe and integrate it into the fabric of the vessel itself is open to interpretation. While we can only speculate about this, it seems that it was done as part of a process undertaken to deliberately sink the boat along with its contents—perhaps as a votive offering forming part of a ceremony connected to the ritual deposition of the boat at the bottom of the lake. The boat had clearly reached the end of its useful life, as evidenced by a 4 m-long crack that had developed along the chine of the port side with no visible attempts at repairs. The aft thickness gauge treenail is also missing, which could have been a deliberate act and would have facilitated the rapid ingress of water, and this, combined with the lack of any apparent effort to plug the voids left as a result of lowering the aft seat, would have led to additional water entering the boat if further use had been attempted.

If the boat was deliberately sunk as part of a votive offering, the question again arises as to the reason behind it. Iron was an extremely valuable commodity in the early Iron Age, and both the spear and axe would not have been placed

![Figure 1.6. Top: Early Iron Age hafted looped and socketed iron axe integrated into the stern seat of the Lee’s Island 5 logboat. Photo by Rex Bangerter, copyright National Monuments Service, Government of Ireland. Below: The iron axe after being recovered from the logboat. Note the semi-circular notch which was cut out of the axe handle so that the round profile of the thwart, when lowered, would fit neatly into the notch on the handle ensuring it was locked in place. Photo by Con Brogan, copyright National Monuments Service, Government of Ireland.](image-url)
The contribution of logboats to understanding our past

within the logboat without due consideration. The boat and its contents do not appear to be a deposition connected with war. Evidence for war deposition weaponry can be seen from the Hjortspring boat, Nydam boats and other Iron Age boats known from Denmark (Crumlin-Pedersen and Trakadas 2003; Van de Noort 2011: 217–221), but the contents of Lee’s Island 5 logboat are a mix of utilitarian objects (work axe and oar) and only a single weapon (spear). Again, there are several suggested reasons that can be considered for the deposition, including to appease a deity and possibly even to honour Manannán Mac Lir, the mythical mariner who ruled the Otherworld and after whom the lake is named. The boat appears to have also reached the end of its useful life and perhaps needed to be disposed of and maybe ritually killed, as is seen with the Kilbeg logboats mentioned above. It may also have been an important boat to the people who made and used it and deserved special attention to mark a long or notable career on the lake. Perhaps it was associated with an important event or battle which occurred on the lake, or a tragedy such as a drowning. Another reason could be the boat was deliberately sunk to mark the passing of a person, perhaps the owner of the boat, one of its crew members or possibly a master craftsman or boat builder who made the boat. The axe integrated into the fabric of vessel may have been the very axe which cut down the tree and helped shape and maintain the boat over time, ultimately to be used as a key component of the ritual deposition of the boat.

There is also, of course, the possibility that the site represents a boat ‘burial’ in water, even though no human remains were found in the vessel during the archaeological excavation. Grinsell (1941) and Van de Noort (2011: 201–221) have both discussed the importance and widespread custom of boat burials in Europe during the Bronze Age, Iron Age and in later periods. Whilst there is no widespread evidence for this practice in Ireland, there is no reason to exclude the possibility for such practices here either. One can therefore ponder if Lee’s Island 5 represents the burial of an important individual who was laid to rest in the boat and submerged in the lake to aid their safe passage to the afterlife accompanied by some of his/her personal or prized belongings. Until these boats were discovered and archaeologically investigated, evidence for the ritual deposition of boats as votive offerings in Ireland was rare, with only a handful of examples known, an example being the deposition of the 15.24 m-long Early Bronze Age logboat in a bog in Lurgan, Co. Galway (Robinson et al. 1999).

Conclusion

The suggestions and ideas presented here by the author require further development and consideration, and those pertaining to ritual deposition highlight that the practice may have held greater significance and widespread prevalence within late-prehistoric societies in Ireland than previously thought. The logboats found in Lough Corrib give rise to numerous questions, and recent specialised publications by Strachan (2010), Goodburn (2019), Tanner (2019) and others, underscore the potential that can be revealed about each individual boat when subject to detailed specialist analysis. Moreover, it is evident that the study of the boats is integral to our understanding of how the local societies functioned and moved on and around the lake throughout time. This in turn can shed further light on activities which may have transpired on other lakes and rivers too, with logboats, sewn plank built craft and probably hide-covered boats in later periods playing vital roles in facilitating travel, trade and the transportation of goods and animals within Ireland’s freshwater environments.

The Lough Corrib logboats, in all their diversity, distribution and density, are of national importance, adding to our record for wrecks and expanding our understanding of the wealth of underwater cultural heritage which remains in the waters around and within Ireland. They are also of international significance. They now form part of a corpus of archaeological discoveries which assist with comparative studies on similar boats from Britain and on the Continent. Due to the number of wrecks in one lake so far discovered, they provide invaluable information on construction techniques, technological changes, boat building skills, function and resource availability. As the range of tools at their maker’s disposal increased in sophistication over the millennia, it allowed for the construction of highly crafted vessels, which no doubt were much prized and cared for, while also reflecting the wider cultural advances in society as whole.

Threats have been identified that could negatively impact or indeed destroy the logboats and their associated artefacts. Surveys and investigations by the UAU are continuing on Lough Corrib, to address the threats but also continue to expand our knowledge of these amazing craft. More extensive study of the wider landscape during all periods represented by the collection of boats is also being done to place the logboats within their wider cultural landscape, and this will be the subject of a series of articles and monographs currently being compiled. More questions will emerge, but it is hoped that so too will more conclusive evidence which will help to clarify many of those questions emerging about the logboats in the lake.

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More than 1,200 islands: narratives of Small Worlds in the Adriatic Sea in Greek and Roman times

Sebastian Adlung and Martina Seifert

Abstract: In the Adriatic Sea, there are more than 1,200 islands of different size and geomorphology between the western and eastern coastal areas. Over time, local communities and traders from different places in the Mediterranean built settlements or emporia, mainly on the larger islands, while smaller islands served as stopover points for maritime transport and trade. In ancient times, for example, the islands Vis, Korčula, Hvar and Palagruža became important through transport, geomorphology and natural environment. Within the context of the settlement of the Adriatic east coast, there is intense debate regarding the role of island communities and their identities as maritime societies in relation to the process of Greek and Roman migration. According to Wilkes, the common narrative includes top-down Romanisation and Roman centralisation, the establishment of the province of Dalmatia by Augustus and the decrease of piracy caused the Italic expansion to eastern Adriatic coastal areas. Aquileia, Pola and Salona were main port cities, with settlers and tradesmen arriving by maritime, fluvial or land routes. This chapter contributes to this topic by addressing the dynamics of settlement development and the interplay of the local communities on Adriatic islands. After a brief overview of selected findings, we consider which concepts of communication and connectivity could be used to describe regional and interregional places and players in more detail in the future.

Introduction

In the Adriatic Sea, more than 1,200 islands of different size and geomorphology are located between the western and eastern coastal areas. Local communities and traders from different places in the Mediterranean built settlements or trading places, mainly on the larger islands, while the smaller islands served as stopover points for maritime transport and trade.

Islands were important as visual landmarks, marketplaces and stopovers, and in Roman times there were probably some major port cities on the islands of the Adriatic Sea, as for example, within the bay of ancient Issa on Vis (Faivre et al. 2012). Presumably, due to location, accessibility, navigability and local supply situation, smaller areas of human interaction emerged. These include the northern archipelago reaching from the islands of Cres and Krk to Trogir, the central southern archipelago off Salona to Dubrovnik, and the central western archipelago reaching west from Vis to Viste and Sipumont on Gargano. In terms of size, number and topography, islands off the coast (e.g. Vis, Hvar, Korčula and Brač) differ from islands in the middle of the Adriatic Sea (e.g. Sušac, Palagruža and Tremiti). The islands near the coast provided diversified settlement areas because their numerous small bays could protect ships from winds or currents. For reasons of navigation and safety, they enabled the creation of shipping routes which generally ran from the Strait of Otranto and reached as far as the Venetian lagoons (Wasmayer 1976). Considering the state of nautical science, sailing along these coasts was a risky venture until recent times (Wasmayer 1976: 200–202). Sea routes of the Adriatic in northern and southeastern directions run along the eastern coast rather than the western one due to various stopping places, as well as a network of lighthouses and coastal lights. In addition to this widely navigable route, island landscapes also offered varieties of smaller routes, both between islands and between islands and the opposing mainland. Numerous ancient shipwrecks with their cargoes at or near the various islands provide valuable information about actors, travel routes and connections between settlements (e.g. Jurišić 2000; Kirigin et al. 2006).

The study presented here contributes to the understanding of human life by linking port research with human activities along the coasts of the Adriatic Sea. Ancient harbours and landing sites along coasts and at rivers or canals of the Adriatic region were critically important to maritime trade (Zaccharia 2001). Here, next to lagoons, plains and mountainous coasts, diverse landscape conditions influenced human activities, for example, in agriculture and crafts, and harbours and landing sites served as locations of departure or destination for sea routes as well. Our study illustrates the need to consider the Adriatic space in a holistic perspective when dealing with maritime trade. It aims to strengthen this perspective by expanding existing discussions about the origins of amphi·orae as products of human craft activities, by incorporating research on harbours and landing sites to create a multifaceted study (Pesavento Mattioli and Carre 2009; Lipovac Vrkljan et al. 2017).
In this research field, an Italo-centric view has long prevailed in questions concerning the production areas of *ampelones*, based on an imbalance of research results. This imbalance has been tackled in recent decades, especially through research conducted in many areas of the Adriatic east coast (e.g. Lamboley et al. 2018; Lipovac Vrklijan et al. 2022). The fact that human activities took place near the coast makes the links between ports, landing sites and the hinterland obvious (cf. Westerdahl 2011: 745). This assumption is strengthened by the fact that *ampelones* as craft products were mass products in maritime trade. If we look at the economic processes behind the production of *ampelones* in relation to their importance for maritime trade, ports and landing sites are seen to play vital roles as places for exporting and receiving goods (Lipovac Vrklijan et al. 2017). The study of the Adriatic, through the investigation of archaeological finds and features on land and underwater on the coasts, thus show economic processes in diverse coastal areas. Even today, the coastal regions of the eastern Adriatic with their offshore islands play an important economic role for the riparian states. Goods for local supply find their way across the Adriatic, and important modern cities such as Pula, Split, Zadar and Dubrovnik are coastal towns which were settled in antiquity (Pavić 2018). An important economic resource is the tourist development of the coastal areas and especially of the islands. It was therefore appropriate to investigate how ancient communities created and used communication routes across the islands, as well as the roles of geographical ranges in trade, transport and formation of settlement communities.

The objective of this chapter is to review how previous interpretations of findings—for example, on the Islands Vis, Korčula, Hvar and Palagruža off the eastern Adriatic coast—fit into common narratives of Greek migration and Romanisation in the Adriatic. The chapter contributes to this topic by addressing dynamics of settlement development and the interplay of local communities on the Adriatic islands. It argues that concepts such as Small Worlds and micro-regions provide an approach which can outline this framework briefly. As a first step, we classified ports according to their range as short-range, middle-distance or long-distance, using the categories proposed by Rickman (1988). The terminology and port nomenclature used is based on the results of the Terminology Working Group of Special Research Programme (SRP) 1630 (Kröger 2018; Werther et al. 2018). Roman terms such as *provincia, regio, municipium, conventus, villa, gens, familia, etc.* followed a discussion of the respective state of research (e.g. Rothe 2018). The terms ‘city’ and ‘hinterland’ played a subordinate role for this study within the SRP 1630: on the one hand, insufficient demographic data were available for our research area, and on the other hand, the findings situation did not permit the estimation of settlement sizes (for a general discussion of the city concept, see Kolb 1984; Zanker 2014). When addressing and classifying settlements, we used their Roman legal status of the time (e.g. *colonia, municipium, oppidum, civitas, vicus or similar*), if it was known.

The impact and formative capabilities of people and their involvement in larger networks of economic redistribution seemed to us to be the most significant (Horden and Purcell 2000: 369–371; Harris 2005: 29–34). Evaluating a heterogeneous body of material in a dynamic, regionally huge research field was a significant challenge for a purely desktop study (Haeussler and Webster 2020: 3–5). This preliminary attempt to identify communication spaces based on tentatively identifiable fields of interaction resulted in a small-scale division of sub-areas. On the one hand, the size and geographical extent of the study area with its western and eastern Adriatic coasts corresponds to the territorial framework of Roman *regiones* and *provinciae*. On the other hand, identified fields of human activity appeared to be partially congruent. The province of Dalmatia, for example, consisted of three judicial districts (*conventus juridicius*) which had their seats in Salona, Scardona and Narona (e.g. Marin 2006; Jeličić-Radonić and Torlak 2019: 1921–1993). The availability of agricultural farmland, natural resources, traffic routes and river connections to the inland characterised the coastal settlement areas in the three *conventus*. Pliny (Plin. Nat. 3, 139; 142–143) provides the most comprehensive information about the *civitates of the conventus*, enumerating in detail the autochthonous *civitates* in Dalmatia (Džino 2014: 222–224). However, it is unclear whether boundaries of administrative districts correspond

A ‘completed’ study and consequent new research questions

The idea for this chapter evolved from the project ‘The Adriatic communication area’ carried out between 2016 and 2019 (principal investigator: Martina Seifert; scientific researchers: Sebastian Adlung and Julia Daum), and it is closely linked to some early results. The project was part of the programme ‘Harbours from the Roman period to the Middle Ages’ set up by the German Research Foundation in 2012 (https://www.spp-haefen.de/en/priority-programme-1630/). Based on desktop studies, our research dealt exclusively with Roman harbours and landing sites for non-military use in the Adriatic area and aimed to analyse Roman harbour building strategies, as well as the role of their initiators, in order understand the economic significance of these ports for regional and long-distance trade. The societies located at the port sites were regarded as relevant players in urbanisation processes, as were the highly functional, networked communities in the micro-regions which were socially, politically and economically relevant to them (Daum and Seifert 2018, 2020; Adlung 2022).
to boundaries of municipalities and provinces in all periods, as well as to geographical or cultural regions (Šašel Kos 2014: 163–164, 2022: 61–70; Džino 2014: 221).

The regional development of boundaries and settlement areas is also connected with a common narrative on settlement history, which sees it as a process of top-down Romanisation, as for example, the establishment of the province of Dalmatia by Augustus and a decrease in piracy led toItalic expansion in the eastern Adriatic coastal area (Bracchessi 2004; Pitassi 2009: 144–156). Wilkes assumed that from Aquileia and Salona, settlements of Italians took place first along the coast and later in the hinterland (Wilkes 1969; for critical aspects and new discussion, see Šašel Kos 2022). In fact, archaeological, literary and epigraphic evidence confirm the role of Aquileia, Pola and Salona as port cities, where settlers and tradesmen arrived by maritime, fluvial or land routes (e.g. Broekaert 2013: 46–48, 58–59, 89–90, 94–95, 166–167). By looking at some gentes, including members of the Statii in Aquileia, many freedmen were active in commerce and the manufacture of bricks (Šašel Kos 2017: 172). The list of comparable coastal locations where similar processes are to be reconstructed could be extended, as for example, to ancient Risinium (Šašel Kos 2017: 174).

Geomorphological features of the natural environment, traffic route connections along the coasts and to the inland and crafts and products, as well as assumed short distance and regional trade, indicate a subdivision into different regions embedded in networks and entanglements (Fioriello and Tassaux 2019). The following regions have been identified: (1) Opposing coasts on the Strait of Otranto (Barium, Brundisium, Hydruntum, Orcum, Apollonia, Dyrrachium). (2) Coast of Gargano (Sipontum, Vieste, Tremitti Islands up to Ostia Aeternum). (3) Coast of Marche (from Ostia Aeternum to Ancona). (4) Coast and lagoons of Emilia-Romagna (from Ancona via Ravenna to the mouth of the River Po). (5) Lagoons on the coast of Veneto (from the mouth of the River Po via Altimum to Aquileia). (6) Coast of Friuli Venezia Giulia and the Amber Road (Aquileia, Emona, Naupactus). (7) West Coast of the Istrian Peninsula and the Gulf of Trieste (Pola, Fažana, Brijuni, Dragonera, Loron, Tergeste). (8) North Croatian islands (Krk, Cres, Rab, Pag). (9) Northern Eastern coast of the Adriatic (from Ad Turres to Aenona and Iader). (10) Central East coast of the Adriatic (from Pakoštane to Salona). (11) Central Croatian islands (Vis, Korčula, Hvar, Brač). (12) Southern East coast of the Adriatic (from Dubrovnik to Lissus). (13) Lagoons on the coasts of Albania (from Lissus to Orcium). (14) Offshore Islands of the Adriatic (Sušac, Palagruža, Pianosa, Tremitti Islands).

A group of ports in the larger settlements played a predominant role in trans-Adriatic traffic, including Ancona, Ravenna, Aquileia, Salona, Brundisium, Dyrrachium and Narona (e.g. Zaccharia 2001; Adlung 2022). Shipping traffic across the Adriatic had to follow the two currents which separate the sea into northern and southern areas. The border zones of these currents lie between the Gargano peninsula and the region around Cape Ploča. Today, only the currents along the southern coast—the islands of Mljet to Apulia, via Issa, Palagruža and Tremeti to Daunia, starting from the archipelago off Iader to Picenum and from the Istrian Peninsula to the Po Valley—favour a direct crossing of the Adriatic Sea (Radić Rossi 2006: 198). Near the Velebit massif, dangerous downwinds are common (Wasmayer 1976). In general, surface waters flow in a northwesterly direction along the eastern coastline, turn around in the upper Adriatic, run in a southeasterly direction along the western side, and leave the Adriatic via the Strait of Otranto (Poulain and Cushman-Roisin 2001). In the north of the Adriatic, tides are noticeable, in contrast to wider areas of the Mediterranean. River inflow also strongly influenced the Adriatic Sea in ancient times (Plin. Nat. 3, 20, 22; Poulain and Raichich 2001: 61–64).

Studies of the eastern Adriatic coast revealed that even within a few kilometres, widely varying settlement patterns existed, formed and influenced by topography, microclimate and other natural or geographical factors, as well as by political and cultural conditions (e.g. Staffa 2002; Carre et al. 2011). Long before Roman settlement and claims of land ownership, coastal settlements made intensive use of shipping to interact with each other (Forenbaher 2009). It is reasonable to believe that at this point, settlements on the coast, both on islands and the mainland, included one or more landing places (e.g. building remains on Sveti Klement on the Pakleni archipelago or along the western coast of Istria; see Carre et al. 2011; Begović Dvoržak et al. 2012). Because the foothills of the mountains reach the sea, the construction of road networks along the eastern Adriatic coast was not feasible in all places. Thus, between ancient Ad Turres and Zeng or between Omniš and Makarska, ships were probably the predominant form of transportation, based on the location and number of ancient shipwrecks in the region (Jurišić 2000; Kirigin et al. 2006). The largest ports developed in mainland coastal towns which were directly connected to the provincial road network (Deluka et al. 2003).

One step beyond the Roman Adriatic: considering the islands of the Central Adriatic

To clarify further questions about the traffic routes in the Adriatic, about trade and communication, it was necessary to look beyond the Roman horizon of the project. It quickly became clear that we could take into consideration only a small part of the research material and questions of the emerging and actively worked research fields (e.g. Jurgović 2019: 111–137; Ugarković and Barnett 2020: 89–122). We want to emphasise that this project did not set out to contribute to the large body of research on the Adriatic islands or critically evaluate the extensive research published in recent times, but rather, its goal was to direct attention to clues to pre-Roman traffic routes. The starting point here was also the question of whether small-scale social or economic communities and/or networks can be grasped through finds from the islands, and the connections
these might have with settlement movements and trade in pre-Roman and Roman times. Accordingly, discussion of the islands of the central Adriatic concentrates on just a few examples from the archipelago between the cities of Split and Dubrovnik.

Access to islands depended on seafaring, and the degree of an island’s seclusion or dependence, in turn, rested on the relationship between seafaring and craft. At the same time, islands were inhabited by maritime-oriented societies, and owners and builders of boats were certainly the active or determining actors in island life. In addition, ancient societies may have understood island inhabitation as an expression of social identity (Boomert and Bright 2007: 13; Kouremenos 2018). Recent debate on the settlement history of the east Adriatic has intensely focussed on the role of island communities and their identities as maritime societies in relation to the process of ancient migration in the Adriatic (Jurković 2019). Recent studies focus on material remains on central Adriatic islands such as Hvar and Vis (Forenbaher 2018a, 2018b; Ivčević et al. 2019; Ivčević 2021). Other works examine finds from islands in the vicinity and their use in antiquity, including sites on Brač with a focus on the evidence for agricultural use or beekeeping (Jelinčić Vučković et al. 2022: 133–136).

The Island Vis with the settlement of Issa is the farthest inhabited island off the central eastern Adriatic mainland (Miše and Quinn 2022: 231, 235). According to literary evidence, Greek migration to Vis and Pharos took place in the fourth century BC from Syracuse (Diod. 15, 14, 2; Kirigin 2006). Before the polis Issa and its city port were established, a trading base must already have existed at this location. At least five Iron Age hill fort settlements...
More than 1,200 islands with Greek and South-Italian painted pottery have been identified on the island. According to Kirigin, one of these sites, Talez, was possibly abandoned by the end of the fifth century BC, when settlement activity shifted to the north coast and Issa was established (Kirigin 2009: 25). In the bay near modern Vis, the remains of ancient Issa comprise necropolis areas, in addition to the enclosing walls. Within the older graves, many objects from Italy, Sicily and Greece have been found, while younger graves contain local fine-ware pottery in addition to imports (Kirigin 2009: 26). Archaeometric analyses of pottery finds from graves yielded the following information (Šegvić et al. 2016: 25–27, 45–48): Many ceramic vessels were made from local resources and are therefore local products. Other objects, however, especially red-figured pottery and Gnathia pottery due to their so-called superior production, are considered imports. Based on identified local objects and the presumed organisation of the workshop, Šegvić et al. assumed Issa was already a noteworthy settlement in the second half of the fourth century BC (Šegvić et al. 2016).

Inscriptions from Issa’s burial contexts show a heterogeneous picture of Greek and Illyrian names, but also names from southern Italy, Thebes and the Peloponnes (Kirigin 2009: 26). In front of the walls enclosing Issa, two pottery workshops were reconstructed through misfires, the remains of kilns, kiln suspensors and moulds for relief ware. One was possibly responsible for amphorae, including Lamboglia 2, while another focussed on fine Hellenistic table ware; both kilns were used from the second half of the fourth century BC to the first century AD (Miše 2018: 55). Ceramic evidence since the third century BC testifies to pottery workshops; these distributed their products mainly in the Central Dalmatian coastal area (Katić 2005: 75; Ugarković and Paraman 2019: 303; Čelhar et al. 2023). These include the type called grey ware from the end of the second century to the first century BC; most of the finds of this type come from graves on the site (Ugarković and Šegvić 2017: 162). Individual objects from Issa have also been found on neighbouring islands (e.g. at Kaštel on Lastovo; see Della Casa et al. 2009: 122).

Three phases have been differentiated for the local production of Hellenistic pottery at Issa, beginning in the middle of the third century BC or possibly the end of the fourth century BC (Miše 2013; Šegvic et al. 2016: 48). Miše identified mainly local production of Gnathia pottery at Issa (Miše 2013: 99–130, 2018: 55). Possibly due to the distribution of so-called Canosian Gnathia pottery, potters from the Canosa area in particular were responsible for establishing workshops on Vis in the mid-third century BC (Miše 2012: 240). Finds from Vis show the cultivation of wine, production of ceramics and transfer of cargo. Around 160 sites have been identified on the island and off its coasts with sherds of pithoi, dolia or amphorae; however, it is unclear whether the items were produced for export from the island or local personal consumption (Kirigin 2012: 287–289). Greco-Italic, Lamboglia 2 and Corinthian amphorae have also been found near the islet Krava in front of the bay of Issa (Radić Rossi 2003: 158–189; Kirigin et al. 2006).

In 230/229 BC, Issa was proclaimed civitas libera et foederata by Rome (Plb. 2, 11, 2; App. II. 2, 7–8). Since...
the first century BC, it had belonged to the administrative territory of Salona (Wilkes 1969; Džino and Domić Kunić 2018: 80–81; Pavić 2018: 206–215). Since the first Illyrian War, entrepreneurs and merchants can be assumed to have been at Issa (e.g. Gaius Fuius; see Milivojević 2010–2011: 194). On site, the remains of a thermae building and sculptural finds can be attributed to the Roman phase (Čargo 2021; Jovanović 2021). Some graves within the necropoles (Martvilo, Vlaška Njiva) were also used in Roman times (Mišić and Touloumtzdou 2016). A few metres in front of the modern quay, there are ancient stone layers under water. Similarities in building materials suggest these blocks belong to the period from the fourth to the third centuries BC and are legacies of ancient harbour architecture (Faiivre et al. 2012: 212–219).

In the first century BC, the harbour area in front of the peninsula expanded; nine perforated dolia date from this period (Jurišić 2000: 77; Pešić 2008: 189). From the late Roman period, findings of African red slip fine ware also indicate a later use of the harbour in the fourth and fifth centuries BC, although settlement and burial finds from this late period are unknown. Likewise, at over 100 so-called farm sites inland, only 26 late Roman pottery finds have been noted (Kirigin 1998: 433–434).

To reconstruct the transfer of goods, information in nautical manuals needs to be included (Wasmayer 1976: 201–207). For example, the Scirocco does not affect the bay of Vis, and it therefore still has a particular importance as a harbour site. Finds of Corinthian vases of the sixth century BC led to the hypothesis that settlers and seafarers from Corfu founded the settlement of Korkyra Melaina on the island of Korčula in the early sixth century BC (Krklec et al. 2011; Radić and Boržić 2017b). According to Greek and Roman sources, the first settlers came from Knidos in Asia Minor (Strab. 7, 5, 5; Plin. Nat. 3, 30). Several Bronze and Iron Age hill forts are known on the island; the best known include Corinthian pottery shards at Blato, and contacts with Greek settlers are assumed from the sixth century BC onwards (Kirigin 2009: 21; Radić and Boržić 2017b: 307–309). Corinthian and Apulian geometric pottery finds from the seventh and sixth centuries BC are known from the sites of Kopila and Velja Silja (Radić and Boržić 2017b: 318). An inscription from the second half of the fourth century BC (the so-called Psephisma of Lumbarda) indicates that later Issaens from Vis founded a settlement on the site of today’s Lumbarda (Bass 1997: 152–158). The inscription, which has survived in several letter form, style and overall impression (Marohnić et al. 2021: 139–140). The inscription fragments were evidently built into a cistern built in the third century BC. The reason the fragments were built into the cistern is unclear (Potrebica et al. 2019: 119).

Preserved are 200 names of Issaean settlers, but also of Illyrians, who may have been negotiators and landowners (SEG 40–511; SEG 43–438). Where an associated settlement was located has been a major point of discussion in the study of the island ever since (Radić and Boržić 2017b: 304). Grave finds at the settlement at Kopila near Blato show that from the fourth century onwards, Illyrians and Greeks lived side by side, while retaining their material culture, as judged from local and imported material in the excavated graves (Radić and Boržić 2017a: 116–117). A series of rural villae formed the core of later Roman land use and migration (Bass 1997: 158–162; Begović Dvoržak and Dvoržak Schrunk 2004). Finds from the sites designated as villae rusticae showed the owners of these estates decorated their own buildings with imported stone materials, and possibly inhabitants of Korčula were also involved in distributing and trading stone materials from the island itself. Several quarries may have been in use in Greek and Roman times (Parica and Boržić 2018: 985–987). Ceramic workshops on Korčula have not been found to date, but they have been assumed (Katić 2005: 79–80). Off the coast of Korčula, amphorae from the fourth to the first centuries BC have been documented in at least ten underwater sites (Radić and Boržić 2017b: 308).

Ancient harbour areas on the island have not yet been localised through architectural remains. Considering natural conditions and distribution of ancient shipwrecks off Korčula, the bays of Vela Luka, Lumbarda and Korčula appear to be suitable locations for ancient harbour areas. The island of Hvar is about 68 km long and no wider than 15 km; the coastline is steep and in the northern central part lies the flat, fertile plain of Stari Grad (Gaffney and Stančić 1992: 113). The island, just like Vis, must have been an important stopover for travel up and down the Adriatic and across to Italy (Mišić and Quinn 2022: 231). Shipwrecks and findings provide evidence for highly frequented sea routes to the bay of today’s Hvar, as well as treacherous conditions for sailing (Jurišić 2000: 63–65, 2006: 177, 181–182). In general, about 230 underwater sites are known to exist off Hvar, the majority of which are on the west coast and mainly between Hvar and the offshore islets; the most common underwater finds are amphorae of the Lamboglia 2 type (Petrić 2014: 9–11, 15). Ancient harbour areas on the island have not yet been localised through architectural remains, but a total of 12 localities off the coasts of Hvar have been identified as potential anchorages based on finds from the seabed (Petrić 2014: 17–18). According to Diodorus, the Parians founded a settlement at Pharos in 385/384 BC with the consent of Dionysius; the site is northwest of the present Stari Grad (Diodorus Siculus XV 15, 13, 4; cf. Gaffney and Stančić 1992: 123). Graves, fortifications and stray finds in caves on the island have been dated to the Bronze and Iron Ages; according to Kirigin, the majority of the 600 known archaeological sites on the island belong to the Bronze and Iron Ages (Kirigin 2009: 22; Kirigin and Barbarić 2019).

Ceramic objects from the eighth century BC testify to contacts with southern Italy. Iron Age sites are located on hills, referred to as hillfort sites (Gaffney and Stančić 1992: 115–117). Greek archaic painted pottery has been found at the site of the later Greek colony (Kirigin 2009:...
During the Illyrian Wars, the destruction of Pharos by Aemilius Paulus is mentioned (Plb. 3, 18–19); however, no traces of such destruction have been found archaeologically (Kirigin 2009: 25). According to Kirigin, none of the sherds found from *pithoi* which have been examined so far could be verifiably classified as belonging to the Roman period. In his opinion, this is primarily because mainly Greek finds come to light in the city area, while Roman finds are known from the area of the Greek *chora* (Kirigin 2017: 59). Of these Roman sites, 27 were identified as remains of Roman farm buildings (Popović 2017: 582, 586). Until the middle of the first century BC according to Kirigin, traces of settlement are detectable from when the island was incorporated into the Roman province of Dalmatia (Kirigin 2009: 24). The survey of Hvar provided evidence the island was populated densely in late Roman times, and this fact stood in clear contrast with the few findings on Vis (Kirigin 1998: 434–435). Excavations in the city area (e.g. in the Burak and Groda areas) provided evidence of several late Roman residential buildings, which together indicate a settlement of this time (Visković and Baraka Perica 2019: 227).

As the westernmost place, the two-kilometre-long island of Palagruža is 40 kilometres away from Sušac, Lastovo and Vis. Palagruža, with its mostly steep coastal sections, has a narrow pebble beach on only its southern shore (Kaiser and Forenbaher 1999). Scholarly research has not identified the ancient remains of harbour constructions so far (Miše et al. 2018: 11–12). Presumably, however, only a part of the southern side served for short-term anchoring, while the narrow beach section may also have allowed smaller boats to go ashore. The earliest finds from the island date from the Neolithic (Miše et al. 2018: 21–22). Bronze Age stone artefacts found on the island are thought to be from the Gargano, while pottery finds from the mid-third millennium BC are known from both opposite coasts and from the Pelopennese. Forenbaher does not assume a permanent settlement on the island, but rather, frequent visits from fishermen and seafarers (Forenbaher 2018a: 249–256).

From Salamandrija, black-figured ceramic vessels from the end of the sixth and the beginning of the fifth centuries BC are known (Semeraro and Kirigin 2017: 211–214). Greek graffiti on pottery sherds, as well as votive offerings, indicate a sanctuary of Diomedes at this site (Kirigin et al. 2009; Miše et al. 2018: 13, 24). A few of the more than 100 inscriptions can be interpreted as indicating that Greek seafarers were headed for Palagruža on their routes to Numana, Adria or Spina in the Adriatic Sea (Kirigin 2009: 31). Attic and Gnathic drinking vessels are similar to those known from the Apulian coast and the east Adriatic islands from the fourth to third centuries BC (Miše 2017; Miše et al. 2018: 24). Finds of figuratively decorated pottery on Palagruža show correspondences with finds from Spina and Adria; according to Kirigin, objects by presumably the same artists were found in all three places (Kirigin 2009: 21).

Ceramic findings show a wider chronological range from the first century AD to the third century AD. Finds from Deposit 4050 include black-gloss pottery, grey-gloss and relief pottery, while thin-walled and lead-glazed pottery were found from the early Roman period at Eastern Sigillata, North-Italian Sigillata and Italian (Arretine) Sigillata. The majority of these finds date from the Hellenistic period.
On Palagruža and nearby islets, archaeologists discovered several shipwrecks (Kirigin et al. 2010). On the reef of Pupak, 600 m to the east, a shipwreck cargo contained Dressel amphorae of type 2–4 and Hispanic vessels from the first century AD. The analysis of tombs at Palagruža suggested these were not conceptual burials; therefore, there may not have been a permanent settlement on Palagruža either (Forenbaher et al. 2013–2014: 96–98, 108). If we look at coins found on the island, there are coins from the fourth and third centuries BC from Neapolis, Luceria and Pharos, as well as Republican coins from the second and first centuries BC from Rhegium, Brundisium, Apollonia and Dyrrachium; striking are the frequent coins from other places, which also show references to Diomedes (Bonačić Mandinić 2013: 371–377).

These few clues to settlement history and the archaeological finds briefly mentioned indicate that Roman locals and Greeks shaped the cultural and political development of the islands of the eastern Adriatic (Ugarković and Barnett 2020; Borzić 2022). Investigations of the amphora finds from Vis (Issa) and Hvar (Pharos) led Katić to assume the differences or the presence/absence of certain amphora types should be understood either as indicating competitive situations between productions or the desire for a differentiation of products (Katić 2005: 79). The same can be said of the distribution of shards from pithoi on Vis and Hvar, where opposite tendencies can also be observed (Kirigin 2017: 59). In another context, Kirigin discusses the possibility of production on Vis crowding out production on Hvar (Kirigin 2018: 405). Shards of pithoi and dolia found at over 200 sites on the islands of Brač, Solta, Hvar and Vis indicate that wine or olive oil was stored. The problem here is that the majority of the finds represent body fragments from surveys or pieces in museums; that is, very few objects have provenance verified by excavations (Kirigin 2016: 187–188). In the context of Vis and Hvar, Miše and Quinn proposed that due to the distribution of finds from amphorae, Pharos on Hvar may have acted more as a redistribution site for objects from the southern Adriatic region, with neighbouring Issa on Vis actually producing and distributing the objects (Miše and Quinn 2022: 225; also see Miše et al. 2019: 237).

Settlement remains and necropolis finds, especially Illyrian grave finds (e.g. on Korčula), attest to the existence of indigenous communities and the establishment of marketplaces on the islands before Greek and Roman migration (Gaffney et al. 2002). Ancient sources mention Greek mobility dating back to the sixth century BC, while in the fourth century BC, Greeks founded the settlements of Pharos on Hvar and Issa on Vis. Archaeological evidence clearly shows mobility from the south to the north Adriatic and from the east to the west (for complex cultural identity, see Šegvić et al. 2016: 25).

Kirigin draws attention to the relationship between local conditions in the Greek and Roman periods: at Pharos in the modern urban area, mainly Greek settlement features are known, while Roman settlement features are found in the area of the Greek chor; here 80 of 129 archaeological sites belong to the Roman era (Kirigin 2017: 59). Another shift can be observed in relation to amphorae. In Hellenistic times in Dalmatia, agricultural products were transported in amphorae of the Corinthian type A and B sourced from different workshops, and this is evident in the heterogeneous loads from shipwrecks. In the south of the Adriatic, the relationship changed in the late Republic period. Loads on ships—for example, Lamboglia 2—were now significantly more homogeneous. This could possibly be attributed to fewer producers and workshops (Miše and Quinn 2022: 225).

Nautical conditions in the Adriatic Sea have always been very complex, as mentioned above. Seafarers and merchants who sailed or crossed the Adriatic surely depended on the large number and safety of ports on the islands and along the coast (e.g. Zaccharia 2001; Radić Rossi 2006). Settlers and traders were certainly involved in ongoing negotiations about passageways and territories (Arnaud 2016: 143–146; for research on the Roman military in the Croatian islands, see Bužanić 2019). Especially controlling access to the Adriatic Sea and the resulting strategic advantages and trade opportunities led to disputes reported by the above-mentioned written sources.

For their maintenance, local communities on islands which managed settlements were partly dependent on trade products from the mainland. Their island status, with accessibility only by sea, often meant they were involved to a lesser extent or in a different way in the conflicts taking place on the mainland (e.g. local communities on Vis and on Hvar regarding conflicts with the Illyrians and Romans as mentioned in the ancient written sources).

Auriemma and Degrassi showed that according to findings of different amphora types in wrecks and settlements, human activity increasingly concentrated on smaller, local areas beginning with the fourth century BC (Auriemma and Degrassi 2015). As far as the fragmentary preserved testimonies allow a generalising statement, the supply situation with agricultural products or the pottery production seems to have been without noteworthy declines until the second and first centuries BC in the region of the Central Croatian Islands with Greek settlements. Settlement traces and burial finds on Vis and Hvar and trade products from
these islands, especially Vis, indicate continuous use of island ports during the Roman Imperial period.

Small Worlds and micro-regions

The brief diachronic look at the island finds from ‘Greek’ to ‘Roman’ times shows how small-scale and complex the regional networks of relationships actually were. To compile a picture of trade, migration processes or local social networks within the region, there are even more factors to consider (for recent studies of maritime networks, see Knappett 2013; Leidwanger et al. 2014; for the terms mobility/connectivity, see Leidwanger and Knappett 2018: 4). In a recent study, Tartaron describes the local scales of Bronze Age maritime networks as presented by the coastscape and the Small World (Tartaron 2018: 89–90). Following the discussions resulting from the Spatial Turn (Bruner 1984: 5; Lawrence and Low 1990: 453–505; Lefebvre 1991: 26, 143; Bachmann-Medick 2006: 284–328) and the Topographical Turn (Wagner 2010: 102; Rau 2013: 104–105), in our study, we understood space as a socio-cultural category, and not exclusively as a topographical-material category. Space as a symbolic construct enables or limits actions as determined by topographical-geomorphological conditions, but which at the same time exceed them. For example, landing sites are water-bound contact zones (Ilves 2011: 8–9, 2013). Communications which take place in spaces defined in this way require contact situations between acting persons. These communications can be established by other means through traffic route relations on land and water, whereby ports and landing sites as traffic spaces occupy an essential interface. Braudel sees traffic routes and movements as the unifying bracket of the Mediterranean world (Braudel 1997), unlike Abulafia, whose study focuses on the sea and coastal cities (Abulafia 2013).

Horden and Purcell understood ancient urban and settlement history as a history of micro-regions. Consequently, they use the term micro-region to describe a complex entity, one which does not refer solely to a topographical and geographical unit (Horden and Purcell 2000). A micro-region means the existing natural environment and the space defined by its inhabitants as being part of it incorporated into economic and social activities. It is not the city as a fixed entity which is significant, but rather, the interaction between its different forms of governance/ economic management, as well as its integration into larger networks of redistribution.

We suggest the concept of micro-region could be useful for this investigation, as it can subsume both the natural space and the space for political, social or economic action. This does not have to coincide with political borders, administrative boundaries and topographical landmarks (Zimmermann 2014: 404) as outlined at the beginning of this chapter. Spatial division models describe, but do not define, the usually fluid boundaries between places and spaces (Hüssén and Gschwind 2012: 161–178; Reinhold et al. 2013: 16–17). The concept of micro-ecologies, which describes the interaction between different forms of management and their integration into larger networks of redistribution, should also serve as a working concept for future studies (Horden and Purcell 2000: 80; Zimmermann 2014: 404).

Along the Adriatic coasts, inhabitants of the regions used different strategies to expand, protect and maintain their communities. Therefore, successful local settlement and survival inherently linked the ways in which people take up the particular issues of a settlement area and establish appropriate structures of varying types. With regard to the islands under discussion, various regions formed communication spaces in the sense of Small Worlds (for the concept of Small Worlds, see Broodbank 2000: 175–210; Malkin 2011; Tartaron 2013; Broodbank 2018; Tartaron 2018: 61–92). They relate regionally, as well as supra-regionally, through economic and political entanglements. Actors, goods, political frameworks and different transport routes provide the connecting links between settlements on the eastern and western Adriatic. Along the east Adriatic coast and on the islands, settlement sites developed in different ways in terms of size and infrastructure.

Concluding remarks

The older scholarly literature, in referring to outdated models of colonisation and the seizure of land (Zippel 1974: 4), assumed the ports for trans-Adriatic traffic towards the eastern Adriatic coast gained importance forItalic trade with the subjugation of the Illyrian tribes (Džino 2013: 145–146). Based on recent concepts, there is need for updated views of Romanisation processes (for a detailed discussion, see Wodtke 2018: 59–120; Haussler and Webster 2020). Roman so-called colonisation in the last years of Caesar’s reign had already brought about demographic- and settlement-related change, so Illyricum had become a frontier zone (Šašel Kos 2011: 107–110; Džino 2013: 156–157). Expanded economic and political access led to an intensification of agriculture for products such as wine, oil and grain, as well as the mining of stone, salt and ores (Alföldy 1965: 196; Begović Dvoržak and Dvoržak Schrunk 2004: 65). According to Džino, in the mid-first century BC, *conventi* of Italic traders existed in Lissus, Narona and Salona, and possibly in Epidaurum and Iader (Džino 2005: 89). Shipwrecks, especially on the eastern and northern coasts (e.g. at Epidaurum; see Parker 1992: 137; Cambi 2001: 139) attest to the important function of large and medium-sized ports in the distribution of goods for the entire Mediterranean region, and they can be traced in the period from the fourth century BC to the third century AD. Here, too, it is important to point out the limited informative value of this study, since, among others, the role of the indigenous inhabitants and their involvement in historic development did not fall within the scope of the research.

An increased development of raw material sources (e.g. stones and metals) apparently took place with the conquest...
of territories by the Romans (Škegro 2006: 149). Near Pataviunum, which received the status of a municipium of the Tribus Fabia in 49 BC (CIL V 267), there were important stone quarries in the Eugan Hills. Narona was considered the last trading post of the grain transport on the Neretva, which led upstream from the Adriatic (Džino 2013: 157). At the same time, settlers arrived at settlements like Narona in several stages (Bekavac and Miletic 2016: 237–238). Strabo emphasized the mercantile as well as the military character of Aquileia (Strab. 5, 1, 8). Naupontus and Emona functioned as trading centres and military bases at the same time.

Case studies on villae rusticae, villae maritimae and piscinae suggest some of their owners were involved in maritime trade and monetary transactions, as well as military administration. The highest quality of land with natural harbours went to important military officers or members of the Roman aristocracy. From this time on, further development and securing of these territories belonged to the remit of their owners (Fontana 2001: 659; Wilson 2011: 50–51). The provinces of Istria and Dalmatia showed a different approach to the practice of granting land ownership (Carre et al. 2011). While in Istria, owners belonged to the elite of the Roman colony and the group of senators, for the villae in Dalmatia, presumably envoys from Rome were sent to take over the administration (Džino 2013: 157). However, the extent to which each architectural finding on the coast or islands can be associated with a villa or a piscina needs to be questioned critically (Begović Dvoržak and Dvoržak Schrunk 2004). Presumably, numerous villae were destroyed by building projects in Late Antiquity. Villae were generally often situated on or near by main roads in the provinces, near urban centres or larger settlements. They functioned to produce agricultural products and deliver goods to neighbouring centres via the developed roads (Tassaux 2007; Bowden 2018).

There is no question that one of the main forces behind the successful incorporation of territories into the Roman Empire was urbanisation (for critical discussion, see Džino and Domić Kunić 2018: 77–78). We should not ignore the role of municipia and coloniae in stabilising Roman rule (e.g. in Dalmatia) in this respect (Bekavac and Miletic 2016: 243). Nevertheless, complex cultural and political interaction processes accompanied the migration processes, beginning with trade, exchange and military expansion, followed by joint settlements or even hostile land seizure, which did not lead to the takeover of power or to the founding of cities, either in general or in all places at the same time. Roman migration in the last years of Caesar’s reign had already caused developments in demography and settlement. In the mid-first century BC, Italic traders appear at Salona, Narona or Lissus, and probably at Iader and Epidaurum (Džino 2005: 89; Milivojević 2010–2011).

The islands of the east Adriatic with smaller-sized, functional ports as discussed here formed important entities by means of transport, geomorphology and natural environment. Because of their significant role as traffic nodes and safe harbours for trading routes, coastal communities emerged and probably carried out specific tasks in intercultural communication and trade. From our current state of knowledge, it is difficult to describe the social, political, or cultural identities of these island communities from the fragmentary archaeological, literary and epigraphic evidence as cited above. The chapter tried to shed light on their entanglements to some regional and interregional places or players. Working with concept such as Small Worlds and micro-region in the Adriatic Sea in Roman times, a few remarks indicate the islands could have played a more central role, probably as stabilising factors, and they could also have acted more resiliently in conflict situations in their small regional contexts. Recent research in Island Archaeology also addresses this question of isolation and connectivity (Dawson 2019: 5).

The interpretation of the findings from the islands Vis, Korčula, Hvar and Palagruža off the eastern Adriatic coast fit the common narrative of Romanisation (e.g. for the province of Dalmatia), but they clearly show the understanding of migration processes and settlement development needs a broader chronological perspective (e.g. findings from Palagruža: Forenbaher 2008: 239). In this chapter, the focus was on settlement and migration movements in Greek and Roman times. However, this limited timeframe should not hide the fact that on many islands, findings from the Neolithic period onwards indicate prior settlement. Coastal connections in the Early and Middle Bronze Age are based on pottery and stone objects, with the central Dalmatian coasts and islands playing a key role (Forenbaher 2018a: 255–256; Arena et al. 2020: 254–255). Within the Adriatic, at least since the eighth and sixth centuries BC, there is evidence of cultural contacts with Greek traders and migrants between opposite coasts, including matches and imports of pottery vessels (Kirigin 2009: 20; Miše 2018: 54). Another research focus is on the Greek ‘pre-colonial’ settlement phases on the islands (Gaffney et al. 2002). The connections between the coasts intensified from the fourth century BC, when Greek colonists migrated to the mainland from the islands of the Adriatic Sea (Džino 2013: 154; Jeličić-Radonić 2015: 23–24). These processes intensify and come to a head in the first century BC, a period characterised by dynamic developments in harbour construction and trade relations (Milivojević 2010–2011: 189–191; Džino 2013: 147).

Ports and landing sites have played a central role since Greek times at the latest, and they retained these in Roman times. Even today, many bays on the east coast, including the example on the island of Vis, are important harbours for ships and boats of the Adriatic water-transport system. The case studies of our research project thus offer insights into ancient connections between maritime links and human activities on the coasts of the Adriatic. At the same time, our research shows that certain stretches of coastline were of great importance in antiquity, but they seem to have lost this significance in modern times. Here, changes
in sea level and land movements emerge as explanations which must always be kept in mind when evaluating ancient coastlines.

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Written sources


Introduction

Being a fisher is not only about having the equipment to catch fish to fulfil the needs of daily subsistence or commercial purposes; rather, it is chiefly a way of living (Mylona 2008: 74). Fishing is not a simple two-way interaction between the fisher and the sea, but rather, an activity whose establishment and development is influenced by technological, social, economic, cultural, biological and environmental factors (Bekker-Nielsen 2010: 187; Cottica and Divari 2010: 363; Marzano 2013: 51–88; Michael 2022: 68–98). As a result, a holistic understanding of the occurrence and nature of fishing in the past can be acquired by considering all these factors/variables together and attempting to perceive fishing as a ‘lifestyle’ of ancient Cypriot communities.

The research presented here is based on the results developed during the author’s PhD research project (Michael 2022), under the supervision of Dr Julian Whitewright, Dr Anna Collar and Dr Jaco Weinstock. According to a substantial literature review, fishing and its subsequent role in the ancient maritime cultural landscape of Cyprus are rarely acknowledged by other scholars (Ohnfelds-Richter 1913; Frost 1985; Desse and Desse-Berset 1994a: 78–79; Michaelides 1998; Egoumenidou and Michaelides 2000: 12; Ionas 2001: 217; Reese 2007; Keleshis 2013; Lindqvist 2016; Knapp 2018: 151; Michael 2022: 15–66). Consequently, this research is the first attempt to explore and determine the occurrence and nature of fishing in the maritime cultural landscape of Cyprus through time, from the Neolithic to the Early Christian periods (tenth millennium BC–mid-seventh century AD).

Through the systematic examination and mapping of the archaeological evidence of fishing gear (harpoons, fish-hooks, traps, stone, clay and lead weights for net or line, fish-ponds) and fishbone assemblages recovered in a variety of archaeological sites in Cyprus, the occurrence, the nature and the regional and temporal distribution of fishing in Cyprus are defined. In addition, the iconographic and written sources, the modern and historical environmental data from modern, archival and ethnographic sources, are a supporting class of evidence which leads to the reconstruction of ancient fishing methods and the understanding of the reasons behind the choice of a specific method, fishing ground or/and fish species.

The chapter emphasises the environmental and cultural aspects of fishing, as it aims to understand how the parallel study of archaeo-ichthyological evidence with the physical Mediterranean environment, the topography of Cyprus and several economic aspects of Cypriot society determined the presence or absence of fishing in the maritime landscape over time. Through the study of three chronological case studies (Neolithic period (9200/9000 BC–4000/3900 BC), Late Bronze Age (1650 BC–1125/1050 BC) and Historic periods (Geometric–Early Byzantine periods: 1050 BC–647 AD) which yield more prominent archaeo-ichthyological evidence, this chapter attempts to comprehend how fishers perceive, value, use

**Abstract:** This chapter examines the interdependent social, economic, cultural, technological and environmental aspects of fishing within the archaeological context of Cyprus. Through this examination, it is possible to understand the human utilisation of maritime space and the relationship between fishers and their maritime cultural landscape on the island of Cyprus from the Neolithic to the Early Christian periods (tenth millennium BC–mid-seventh century AD).

Heretofore, fishing in Cyprus has been neglected from an archaeological perspective. Consequently, the research presented here studies the archaeological evidence of fishing gear with the fishbone assemblages and the iconographic and written sources to determine the establishment and development of fishing in Cyprus diachronically. Environmental and ethnographic data are used to examine how the island’s topography and physical Mediterranean environment determine the presence or absence of fishing within its maritime landscape. Through this study, an attempt to recover the mental maps of fishers is conducted by trying to reveal fishers’ choices of specific fishing grounds, gear and/or fish species. Consequently, this study attempts to provide a comprehensive understanding of the human daily activity of fishing in Cyprus diachronically. Subsequently, it contributes to understanding the life of fishing communities in Cyprus through maritime archaeology.
and move through their landscape and seascape. Thus, a potential explanatory framework for understanding fishers’ perceptions and spatial preferences to establish and develop fishing can be proposed. Consequently, this chapter delves into how the concept of the maritime cultural landscape—the human utilisation of space through the daily activity of fishing (Westerdahl 1992: 5)—might be understood and investigated in the archaeological context of Cyprus.

Accessing maritime cultural landscape of fishing communities: theoretical approaches

Fishers are people who interacted with the maritime environment (coast, estuary, sea, ocean) and navigated the seas and coasts to find the best fishing grounds every day. Thus, they developed and nurtured the local maritime knowledge, which can perceptually construct fishers’ mental maps of their known maritime environment (McKenna et al. 2008: 5; Obied 2016: 157; Michael and Obied 2022: 151–155). Through this knowledge, fishers can decide where and when to fish, whether to create and use a particular gear, whether to choose and use a specific fishing ground and whether to fish a specific fish species. These decisions are also affected by many technological, natural, social, economic, cultural, biological and environmental variables because fishers live and interact within a natural, social, religious, economic, administrative and cultural environment (Figure 3.1).

Meteorological knowledge (currents, winds, temperature), navigational skills, the ability to manufacture and maintain tools and equipment, as well as fishing skills and resource availability, which are some broadly defined variables of the specialised knowledge (mental maps) which fishers have, influence the decisions of a fisher relating to the establishment and development of fishing or the creation and alteration of fishing gear (Figure 1; Morrill 1967; Acheson 1981: 290–291; Wilson 1990: 28; Palsson 1993: 124–129; Sabetian 2002: 22–23: 30; Sosis 2002: 588–591; McNiven 2003: 330–332; Cooney 2004; Westerdahl 2007: 207–208; Morales-Muñiz 2010: 28–29; Duncan 2011: 273; Van Dolah et al. 2020: 1757–1758). In addition, fishers acquire a knowledge of ecology (the seafloor ground) and more specifically, how fish species behave daily, seasonally and annually in their life cycles, as this assists in understanding the marine environment, where fish species live and fishers interact with them, in order to catch them (O’Sullivan 2003; Duncan 2011; Theodoropoulou 2011; Aswani 2020: 481; Michael 2022: 78). Considering these variables of specialised knowledge (mental maps) which can be chosen, as well as inherited or implicit, is essential because they determine generally where, when and how they established fishing in the past (Bird and Bird 2000: 472–473; Parker 2001: 33–34; Mylona 2008: 67; Michael 2022: 74).

Thus, it is essential in interpreting the archaeology of fishing to start by supposing how fishers interacted with and perceived the physical and cultural space specifically, where they live and fish. In Cyprus, the physical space, where fishing is mainly carried out, is the coast and continental shelf. The continental shelf is defined as the seafloor at water depths shallower than 200 m (Demetropoulos 1985: 70; Department of Fisheries and Marine Research 2012: 2). This environment is generally narrow in the north and wider in the south and at maximum extends about 16 km from the shore. Also, it slopes seawards to very deep water practically from the

![Figure 3.1. Theoretical diagram presenting the tangible and intangible variables affecting the decisions of creating and developing the fishing. Image by the author.](https://doi.org/10.30861/9781407361475)
Maritime cultural landscape of fishing communities in Cyprus

In 1992, Christer Westerdahl (1992: 5) introduced the concept of the maritime cultural landscape in an attempt to observe and interpret the maritime aspect of a landscape, including the sea, the shoreline and the coastline. The term has become a useful analytical tool in the case study of fishing because it comprises the physical and cognitive aspects of terrestrial space (landscape) and a marine space (seascape) for investigating and comprehending the culture of maritime people within a spatial context (Westerdahl 2007: 212–215, 2011; Ford 2011: 4–5; Michael 2022: 78–90, 327–333, 356–360, 399–403).

However, it is difficult for the physical and cognitive aspects of a maritime cultural landscape to be brought into view through the isolated study of the archaeological data alone; as a result, researchers use ethnographic datasets, including folklore, oral histories, contemporary local knowledge and the traditions of a fishing community (Kirch and Dye 1979; Parker 2001: 34; Duncan 2011: 267–268, 275–281; Aswani 2020: 476, 479; Michael 2022: 83–84, 217–254).

Ethnographic sources of human-marine interactions consist of research on human ecology, cultural and societal values, political relations and socio-economic institutions (Aswani 2020: 476; Thurstan 2022: 357). For instance, the use of traditional ecological knowledge, which encompasses the knowledge, practices and beliefs of local communities whose lives depend on the natural environment, can reflect social behaviour and aspects of marine resource use and how the landscapes and seasapes were organised and utilised in the past (Calamia 1999: 3–5; Huntington 2000: 1270; Teixeira et al. 2013: 241–242). This knowledge develops across generations and passes down mainly as an oral tradition (Teixeira et al. 2013: 241–242). Also, the use of historical knowledge of ecology from historical written materials, imagery and public, private and government archives increases the understanding of the dynamic nature of landscapes and provides a framework for a detailed understanding of the type, scale and consequences of fishing over the past until the present day (Swetnam et al. 1999: 1190; Szabó 2015: 1001–1005; Aswani 2020: 475–476; Crumley 2021: 1–2; Thurstan 2022: 351, 353).

Consequently, this methodological approach enables land and sea to be perceived in the way fishers did in the past in order to explore potential interpretations about fishers’ thoughts, beliefs and decisions (Palsson 1993; Johnson 1999: 86; Parker 2001: 39; Barber 2004: 444; Cooney 2004: 324; Westerdahl 2007: 214; Westerdahl 2011: 751; Knapp 2018: 31). In other words, it helps in reconstructing the mental map of the space, which fishers have formed to know how to choose the right fishing ground and the most effective fishing method since the earliest human exploitation of the sea (Parker 2001: 33–34).

Although this methodological approach benefits the examination of past fishing, it must be conducted cautiously. Ethnographic sources, historical ecology and archaeological data should be compared only if they come from the same region and share similar technological knowledge or social organisation (Wheeler and Jones 1989: 175; Nédélec and Prado 1990; Swetnam et al. 1999: 1201; Bekker-Nielsen 2010: 201; Ono 2010: 279; Marzano 2013: 3, 302; Trakadas 2018: 88–89). In the case of Cyprus, ethnographic, archaeological and historical ecological evidence are both from the same geographical and climatic zone. Consequently, an ethnoarchaeological approach, which mainly focuses on the parallel examination of the main indicators of fishing (fish remains and evidence of fishing gear) with ethnographic evidence, seems appropriate for examining past fishing in Cyprus in order to understand and reconstruct the maritime cultural landscape of Cypriot fishing communities.

Methodological approach

As revealed from the discussion, the concepts of the maritime cultural landscape (terrestrial space and marine space–seascape) and historical knowledge of ecology can be analytical frameworks which use an ethnoarchaeological approach to understand fishers’ decisions of where and when to develop fishing activity and what to fish. The material, which was examined for the purposes of the current research, has been mainly derived from an intensive desk-based study.

First, an intensive desk-based study of the published final reports of Cypriot archaeological sites and museum inventories was conducted in order to collate the archaeo-ichthyological evidence, which mainly includes artefacts related to fishing methods and fishbone assemblages (Michael 2022: 19–23). The archaeological context of the archaeo-ichthyological evidence was also studied for further information about the social, economic, administrative and cultural processes occurring and potentially impacting the establishment and development of fishing in Cyprus diachronically. Simultaneously, fieldwork focussed on the examination of the excavated archaeological finds was also conducted in order to achieve better and more suitable documentation. All this information was archived in a database (Michael 2022: 127–131, 257–300). Through this systematic recording and visual mapping of archaeological sites where archaeo-ichthyological evidence has been recovered, temporal and spatial patterns were also revealed (Jacobsen 2005: 103; Michael 2022: 406–411). This approach highlights the presence and absence of fishing in different chronological periods or areas.
The desk-based study also encompassed iconographic and written sources dated in the studied time (Michael 2022: 50–62). Regarding iconographic representations of fishing, their number is extremely limited in Cyprus, and they are not found in all chronological periods (they are mainly found in the Geometric to Roman periods, 1050 BC–330 AD; see Karageorghis and des Gagniers 1974: 50, 229; Karageorghis 2006: 69, 99, 127). As a result, iconographic representations of fishing methods and gear from other areas in the Mediterranean region were considered in reconstructing the fishing methods, especially if they have not preserved in the archaeological records (Ayodeji 2004: 231, 438: Fig. 151; Michael 2022: 121).

Also, the written sources used in the study consisted of the geographical and natural science treatise by Oppian (Halieutica) and the agricultural manual of Columella (De Re Rustica); these mainly provide information about the Classical and Roman periods (Michael 2022: 123). The information derived from these sources was compared with the ethnographic and historical data in order to reconstruct the ancient fishing methods and understand the reasons for choosing specific methods in specific fishing grounds.

Furthermore, the physical context of Cyprus was examined mainly on historical, modern and ethnographic data in order to understand how fishers adapted to environmental conditions and how this adaptation affected their choice of fishing grounds, gear and/or fish species. The ethnographic data were chiefly derived from 110 interviews with fishers from the community which established fishing in Cyprus during the nineteenth and twentieth centuries. These interviews are deposited in the Archive of Oral Tradition and Folk Study (Cyprus Research Centre). The main sources for the modern marine biological and geomorphological data and the bathymetric data are the publications and archives of the Cypriot Department of Fisheries and Marine Research, which include data since the 1950s. Finally, the geomorphological changes and the impacts of past sea levels on the coast were considered because they might contribute to the alteration or extinction of marine habitats, past fishing grounds and littoral topography.

Main indicators of fishing in the past: Fish remains and evidence of fishing gear

As already mentioned, the current research focusses on the study of the main indicators of fishing, which are distinguished by fish remains and archaeological evidence of fishing gear consumed or used respectively and finally recovered in inland, coastal and underwater archaeological sites in Cyprus (Figure 3.2). Through intensive desk-based study and fieldwork, 74 archaeological sites dating from the Neolithic period to the Early Christian period (tenth millennium BC–mid-seventh century AD) yielded evidence of fishing gear and fish remains (Figure 3.2; Michael 2022: 104–105). The temporal and spatial contexts of some of them could not be determined, and as a result, important contextual information which would help their further interpretation was absent. Consequently, their temporal or/spatial contexts were characterised as unknown.

The systematic mapping of these archaeological sites demonstrates the extent of this evidence and contributes to the further investigation of the correlations between these data and their maritime environment (landscape and seascape). According to the former definitions and interpretations of the mapping space (landscape and seascape) of Cyprus (Vogiatzakis et al. 2017: 7), Cypriots engage more with maritime activities within the area 10 km from the coastline towards the inland part of Cyprus (Figure 3.2). The seascape of Cyprus from the coastline to the sea extends only 15 km (Figure 3.2), which is the area of the continental shelf of the island.

Although the spatial distribution of the main indicators of fishing in Cyprus highlights the fact that the engagement of Cypriots with fishing is mainly along the coastline or/and within the area 10 km from the coastline towards the inland part of the island. However, there are also sites with evidence of fishing beyond the Cypriot defined maritime environment (Figure 3.2). In addition, the identification of evidence of fishing in the same area leads to the hypothesis that Cypriots presumably decided for environmental, cultural or/and economic reasons to engage in fishing in some areas diachronically. Before exploring and identifying the reasons for the presence or absence of fishing in some areas throughout time, it is important to briefly describe the available main indicators of fishing in Cyprus to provide an overview of its nature and inherent issues.

Fish remains

Fish remains are the primary indicator of fishing, fish consumption and preservation and trade within an archaeological context (Casteel 1972: 406–416; Wheeler and Jones 1989: 3, 7, 162–176; Reese 1991; Rose 1994: 448–476; Morales-Muñiz 2010: 31–32). Identified and unidentified fish remains have been recovered from 54 sites distributed throughout Cyprus. There are 12 sites which yielded fishbone assemblages dated to the Neolithic period, four sites to the Chalcolithic period, 21 sites to the Bronze Age, two to the Cypro-Archaic period and six sites to the Hellenistic/Roman periods. There are also some sites which have produced fishbone assemblages from several periods.

Although fishing seems more intense during some periods because of the number of sites, the number of sites is not representative regarding the number of fish remains recovered. The numbers of fish bones from many sites are not provided, or they are mainly very small or/and unquantified; as a result, many fishbone assemblages vary greatly from just one to two bones to over a thousand. This is a result of the non-systematic use of dry and wet sieving in many excavations and the absence of using reference collection to identify fish species. These issues
cause difficulties in defining the intensity of fishing during the different chronological periods or between different sites. To overcome these issues, each identified species has been considered here as a unique occurrence within the chronological context in which it was recovered, while unidentified fish remains have been simply noted as present (Locker 2007: 144; Trakadas 2018: 53–54; Michael 2022: 107–112).

This approach identified 61 taxa of fish in the archaeological sites of Cyprus through time (Table 1). In addition, it shows that more identified fish remains have been simply noted as present (Locker 2007: 144; Trakadas 2018: 53–54; Michael 2022: 107–112).

Evidence of fishing gear

Fishing gear is the other main indicator of fishing in the past. Its study can be characterised as challenging, as it can be often described as multi-use or as miscellaneous objects (Bolger 1988: 91; Vermeule and Wolsky 1990: 73, 94, 130, 146; Swiny et al. 2003: 227, 230; Steel 2004: 58; Stewart and Rupp 2004: 163, 167–170; Peltenburg and Christou 2006: 16–17; Bürge and Fischer 2018: 473–485; Mantzourani 2019: 317–318). Consequently, fishing gear can be difficult to recognise and identify.

Despite these limitations, evidence of fishing gear has been recorded at 48 archaeological sites in Cyprus. Nine Neolithic sites, two Chalcolithic sites, 12 Bronze Age sites, two Cypro-Geometric sites, two Cypro-Archaic sites, two Cypro-Classical sites, 18 Hellenistic/Roman/Early Christian sites and one site with an unknown chronological context produced evidence of fishing gear. This evidence mainly consists of fish-hooks and stone and lead weights; their quantity differs from period to period (Figure 3.3; Michael 2022: 257–300). Also, three sites with fish-ponds, which are rock-cut basins built entirely on the coast and
Table 3.1. Occurrence of identified taxa (species and families) in Cypriot archaeological context through time. Compiled by the author.

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filed with salt water in which live fish were kept, date to later periods (Roman and Early Christian). As already mentioned, the limited quantity of fishing gear in some periods may be the result of methodological approaches (Michael 2022: 15–66, 163–192).

Regarding fish-hooks, they have different sizes, shapes and materials over time (Figure 3.4). The earliest ones are smaller, made of bone and have a half-circular shape, while the latest ones are bigger, made of copper or bronze and have a ‘J’ shape. At the top of their shanks, there is usually an eye or groove where the line would be tied, while some of them have a sharp barb. Bone and bronze gorges have also been recovered. The recovery of hooks and gorges indicates the use of fishing lines, while the different sizes and/or shapes of hooks determine if they were used on multiple or single hooked lines and/or used to catch large or small fish (Bernal-Casasola 2010: 89; R. Thomas 2010; Michael 2022: 368–369). In addition, the use of fishing lines is also defined by the recovery of weights with a solid body formed from a lead mass and a groove, a hole or a ring for a line attachment (Figure 3.4; Galili et al. 2002: 183–184).

Fishing nets, in comparison, are not generally preserved in the archaeological record because of their perishable materials. Only their clay, stone and lead weights and metal needles are preserved (Michael 2022: 257–300, 375–377). Net weights, which were fastened/fixed on the ground rope of a net to help it to sink, were generally shaped like tubes or folded in one plane, or they are small pebbles with a straight perforation for the rope (Figure 3.4). The most common type of this category is the folded rectangular lead weight, which was bent over the ground line of the net (Figure 3.4; Galili et al. 2002: 183–184). Larger stone weights with straight perforations for rope were used on the net edges to anchor it (Figure 3.4).

Furthermore, the comparison of ethnographic data with written and iconographic evidence from Cyprus and the wider region of the eastern Mediterranean reveals that some other fishing methods, including fish poisoning and basket-traps, were used during the Classical and Roman periods, but they did not leave any archaeological trace to establish their use (Michael 2022: 235–240). In addition, through the examination of oral histories about these fishing methods, it is possible to comprehend how fishers carefully observed, adapted and used their knowledge of the environment and animal behaviour to their advantage.

Regarding the method of fish poisoning, it is difficult to observe in the archaeological record because the archaeobotanical analyses did not clarify whether ichthyotoxic plants were available in the past (Michael 2022: 413). On the other hand, the comparison of written sources with ethnographic data from Cyprus highlights that this method was employed during the Roman period in the same way it was employed during the early-modern period in Cyprus (Hal. 4.647–693; Michael 2022: 235–236, 413–414); as a result, this method appears to have been used, but the perishable nature of the evidence meant it could not be identified archaeologically.

Finally, the simultaneous study of Classical iconographic representations with the corresponding description in the Roman written sources of traditional Cypriot baited basket-trap demonstrates the ancient use of this fishing method survived in traditional knowledge through time, despite no evidence existing within the archaeological records (Hal. 3.414–431, 4.40–74; Ayodeji 2004: 231, 438: Fig. 151; Michael 2022: 237–240, 414). Through the examination of oral histories about this method, it is also possible to distinguish the existence of specialist knowledge about how to exploit individual fish species and their favoured habitat conditions. For instance, modern Cypriot fishers sail to a specific location early in the morning and feed the fish prior to dropping basket-traps in the sea (Keleshis 2013: 63–64; Michael 2022: 239). When a lot of fish gather in the area, they drop the trap, whose design is based on the behaviour of fish to avoid their attempts to escape when they get inside (Figure 3.5). The trap is collected full of fish a few hours later. The same practice is described by the Roman writer Oppian (Hal. 3.414–431, 4.40–74); as a result, it seems that Cypriots follow the same practice when they fish by using basket-traps as the Roman fishers, but the perishable
nature of this method is the main reason it is invisible in the Cypriot archaeological record.

Exploring the maritime cultural landscape of fishing communities in Cyprus: analysis and discussion

As the methodological approaches and the available main indicators of fishing in Cyprus have been presented briefly, some case studies dated in different chronological periods have been chosen to highlight how Cypriot fishers adapted to environmental conditions and how these conditions affect fishers’ decisions of establishing and developing fishing in the past. Through this study, it is possible to clarify how the different topographical characteristics of each archaeological site, where main indicators of fishing have been recovered, could affect how Cypriots

Figure 3.4. Evidence of fishing gear recovered in a variety of archaeological sites dating from the Neolithic to the Early Christian periods (tenth millennium BC–mid-seventh century AD). (a-b) Neolithic bone hooks and gorges from the archaeological site of Cape Apostolos Andreas, Kastros; source: Le Brun 1981: 203, Fig. 56.3–4, 10–11. (c) Neolithic stone weights from the archaeological site of Cape Apostolos Andreas, Kastros; source: Le Brun 1981: 181, Fig. 56.8–9. (d) Folded rectangular lead net weight from the Late Bronze Age site of Athienou; source: Dothan and Ben-Tor 1983: 126, Fig. 57.18–20, 128–129, pl. 47:4. (e) Limestone net weights from the archaeological site of Kition-Bamboula; source: Frost 1985: 173, Fig. 79. (f-g) Hellenistic bronze hook and lead weights from the archaeological site of Amathus; source: Michael 2018: 109, Fig. 4.

Figure 3.5. Paintings by fisher Andreas Keleshis presenting fish basket-traps with or without a boat. Source: Keleshis 2013: 22.
comprehended their maritime environment. In turn, this information will assist in hypothesising and understanding how fishers navigated, identified or choose specific fishing grounds and/or fish species to catch.

**Case study of the Neolithic period (9200/9000 BC–4000/3900 BC)**

The first case study is the Neolithic site of Cape Apostolos Andreas, Kastros (Aceramic Neolithic: 9200/9000–5200/5000 BC). This site is located on the most northeasterly point of the Carpasia Peninsula and combines environmental characteristics from both the south and north coasts of Cyprus (Figure 3.6; Le Brun 1981; Reese 1978: 87–88). On the south side of the peninsula, the morphology of the seabed is mainly soft with sand and gravel or muddy (Department of Fisheries and Marine Research 2012: 39). The north side of the peninsula is rocky and dominated by hard limestone with patches of mixed sediments of coarse sand gravel (Department of Fisheries and Marine Research 2012: 39). Also, on the north side of the peninsula, meadows of Mediterranean tapeweed/seagrass (*Posidonia oceanica*) have been recorded in recent studies about their current distribution in the eastern Mediterranean (Telesca et al. 2015: 7: Fig. 4). Consequently, it seems the north side of the peninsula can be characterised as a fertile fishing ground, as meadows of Mediterranean tapeweed/seagrass (*Posidonia oceanica*) are a fundamental source of nutrition in marine environments (Campagne et al. 2015: 394; Jackson et al. 2015: 903; Michael 2022: 330). Consequently, the simultaneous examination of the environmental conditions with archaeo-ichthyological evidence recovered at the site of Cape Apostolos Andreas, Kastros can propose that the distinctive topography of this area could contribute to the growth of a strong relationship between fishers and their environment, which in turn may have affected fishers’ decisions of where and how to develop fishing in this area (Michael 2022: 327–333).

Furthermore, more than 6,000 remains of bony fish have been found at this site, 3,888 of which have been anatomically identified (Garnier 1981: 93–94; Desse and Desse-Berset 1994a, 1994b). Although the fish remains are fragmentary and poorly preserved, this fishbone assemblage seems to be a representative assemblage of mixed exploitation of coastal and pelagic resources at

![Figure 3.6. Map defining the landward and seaward buffers of Cyprus (land and coastal zones of Cyprus) in relation to the Neolithic sites. The landward and seaward buffers have been defined based on the generally acceptable former interpretations of Vogiatzakis et al. (2017: Fig. 1). The site of Cape Apostolos Andreas, Kastros is marked as discussed in the text. A detailed map defining the bathymetry of the site of Cape Apostolos Andreas, Kastros. Bathymetry: red, 50 m depth; yellow, 100 m; green, 200–500 m. Produced by the author on ArcGIS. Source for layers of Hillshade Coastline: Department of Lands and Surveys, Cyprus (DLS Portal); source of the basemap: Esri Garmin, NCAA NGDC and other contributors; source of the bathymetry: EMODnet; layer of archaeological sites produced by the author.](image)
the subsistence level (Michael 2022: 259, 324–326). It mainly consisted of fish species living at depths of 1–100 m, confirming the continental shelf was the area where fishing was carried out mainly (Figure 3.6; Michael 2022: 327–328). On the other hand, remains of pelagic fish have also been recovered from this context. Most of them migrate close to the coast either seasonally or daily according to currents, temperature differences, spawning season or their marine habitats and age; as a result, their occurrence supports the exploitation of pelagic resources, but at the same time, it is possible they were caught during their migration near the coast (Michael 2022: 325). Consequently, it can be hypothesised the continental shelf could have been the main area of fishing, but the inhabitants of this site may have put more effort into sailing and exploiting the pelagic resources beyond the continental shelf. It has also been noted that sailing in this area was challenging during the Neolithic period, and this may demonstrate the good sailing skills of its inhabitants in exploiting pelagic resources (Bar-Yosef Mayer et al. 2015: 426–429).

**Case study of the Late Bronze Age (1650 BC–1050 BC)**

Moving to the Late Bronze Age period (1650–1050 BC), the site of Hala Sultan Tekke, which is on the southern coast of Cyprus, also highlights how the characteristics of its landscape and seascape affect fishers’ decisions of where, when, what and how to fish (Figure 3.7; Michael 2022: 356–360). The present coastline in this area is characterised as lowland, and it is now some distance from the ancient shoreline due to sedimentary infilling (Gifford 1978; Thomas 1981). Based on the relatively recent intensive study of coastal alterations in association with archaeological evidence recovered at the site of Hala Sultan Tekke, a confined lagoon existed and was used as a harbour during the second millennium BC from the site of Hala Sultan Tekke (Gifford 1978: 166–169; Devillers et al. 2015: 75–78). This lagoon was finally eroded and silted to form the Larnaca Salt Lakes which exist today (Figure 3.7).

Lagoons offer fertile fishing grounds exploited by human settlements throughout the Mediterranean basin, as seagrass meadows are one of their main characteristics (Rose 1994: 53, 101–102; Broodbank 2013: 158–159; Marzano 2013: 199–205; Crosetti et al. 2015: 22, 24, 28; Kleitou et al. 2020: 12). Based on studies (Telesca et al. 2015: 7: Fig. 4), Mediterranean tapeweed/seagrass (*Posidonia oceanica*) exists along the present coastline of Hala Sultan Tekke. The occurrence of Mediterranean tapeweed/seagrass (*Posidonia oceanica*) may date to the Late Bronze Age because the study of the alteration of the coastline showed a *Posidonia* bed existed when the lagoon was in use as a harbour (Devillers et al. 2015: 78). In addition, the recovery of fish species living in lagoon environments such as gilthead seabream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*), flathead grey mullet (*Mugil cephalus*) and thinlip grey mullet (*Chelon ramada*) within the fishbone assemblage of the site of Hala Sultan Tekke also supports the exploitation of the coastal lagoon for fishing (Crosetti et al. 2015: 30–31; Michael 2022: 357).

In addition, comparisons between modern meteorological information and studies of modelling ancient winds and currents in the region of the eastern Mediterranean show the prevailing current and wind patterns have not changed remarkably since ancient times (Murray 1995; Leidwanger 2020: 31). Consequently, the predominant currents and winds in this area seem to benefit the exploitation of the lagoon ( Meteorological Service 1986: 9; Safadi 2016: 353–355, 2018: 229, 259; Michael 2022: 358). The light southerly sea breezes—the predominant features in the area, especially during the winter and summer times—may create southerly currents, which in turn ‘force’ fish to enter the lagoon to find food; as a result, they would have been easy to catch within the area of the lagoon or along the coast. Consequently, the parallel study of currents along the present south coast with the archaeological evidence indicates the lagoon may have been exploited by the inhabitants of Hala Sultan Tekke. In addition, fishing seems to have been an activity which relied on accumulated knowledge and mental maps of the landscape and seascape of an area for the choice of a fertile fishing ground.

Evidence of fishing gear and fish remains dated to the Late Bronze Age (1650–1050 BC) have been also recovered from inland sites located within an area beyond the theoretical knowledge of the seascape (Figures 3.2, 3.7; Michael 2022: 347–349). More prominent evidence has come from the archaeological site of Apliki-Karamallos, which was a small copper-mining settlement (Figure 3.7; Du Plat Taylor 1952). As lead-folded rectangular fishing sinkers with fish remains have been recovered, the use of fishing nets is attested there (Michael 2022: 270, 348). However, the limited evidence and its location suggest the inhabitants of this site did not directly engage in fishing, but their fish supplies were probably acquired as the result of a local complex exchanging network. This complex exchanging network existed between the several Cypriot Late Bronze Age sites distinguished from primary coastal centres, inland centres, agricultural villages and mining sites (Catling 1963: 144–145; Karageorghis 1982: 61–63; Keswani 1993: 76–80; Georgiou 2018: 82–88). Based on this exchange network, subsistence and utilitarian goods, copper and its products and other essential or prestigious objects were distributed between the sites.

In the case of Apliki-Karamallos, it seems its inhabitants exploited copper and provided it to the inhabitants of a primary coastal centre, most probably the site of Tolumou Skourou (Figure 3.7), and at the same time, they obtained subsistence and utilitarian goods from this primary coastal centre. Fish may have been included in these goods. Consequently, the examination of fish remains and fishing gear within their topographical and contextual depositions of inland archaeological sites...
suggests their existence in these contexts may be ascribed to local administrative and/or economic factors.

**Case study of historic periods (Geometric to Early Byzantine periods: 1050 BC–647 AD)**

Moving to later periods, Amathus is also an excellent example of an archaeological site with evidence dated from the Archaic (750–480 BC) to Early Christian periods (330–647 AD) which can highlight the importance of the knowledge of the maritime environment in the growth of fishing. Amathus is located on the south Cypriot coast and it represents evidence related to fishing from both terrestrial and underwater contexts (residential area and harbour) (Figure 3.8; Empereur 2017; Michael 2018a, 2018b).

Although oral traditions understood through fishers’ interviews highlight the fact the south Cypriot coast has no fertile fishing grounds, the simultaneous study of Amathus’ archaeo-ichthyological evidence with the environmental characteristics of its coast and seabed shows fishers acquired specialised knowledge of their marine environment which enabled them to navigate and identify key fishing grounds (Michael 2022: 218 399–403). This contrast seems to be a result of coastal alterations which happened along the south coast over time because of very severe erosion in conjunction with eustatic sea-level changes and tectonic activity (Thomas 1981; Andreou et al. 2017: 201). These changes led to the submergence of Amathus Harbour and the erosion of the coast (Empereur 2017: 111–120). Consequently, these alterations should be considered during the examination of ancient fishing, as places which are now perceived as not being fertile fishing grounds may have been fertile in the past.

The fertility of the fishing ground at Amathus may be a result of specific environmental characteristics found in this area of the south coast. For instance, the upwelling phenomenon, which is strong in this area during the summer months and enriches surface water with nutrients, is possibly the reason for the presence of seagrasses (Figure 3.9; Department of Fisheries and Marine Research 2012: 10–11, fig. 1.8; Demetriou et al. 2022: 12). The marine environment of Amathus consists mainly of Mediterranean tapeweed/seagrass (*Posidonia oceanica* and *Cymodocea nodosa*) and green alga (*Caulerpa prolifera*); these seagrasses transfer nutrients to food webs,
provide essential habitat for many species and contribute to fishing (Department of Fisheries and Marine Research 2012: 53–55; Campagne et al. 2015: 394, 396; Jackson et al. 2015: 900; Kleitou et al. 2020: 1–2). These seagrasses may be ancient, as the remains of fish species living mainly in a substrate with seagrass meadows from depths of about 1 to 50 m have been recovered within Amathus’ fishbone assemblage (Department of Fisheries and Marine Research: 2012: 53–55; Kleitou et al. 2020: 2, 12; Michael 2022: 401–402). Consequently, the presence of seagrass meadows within this area provides a fertile fishing ground which was exploited by the inhabitants of Amathus.

During summer, when the upwelling phenomenon occurs, the local wind patterns, which become predominant features, also favour the growth of fishing in this area. The northerly land breezes developed at night help fishers to sail or row in calm weather offshore, and the light southerly sea breezes developed during the whole day help them return safely to the coast (Meteorological Service 1986: 9; Michael 2022: 401–402). Consequently, the presence of seagrass meadows within this area provides a fertile fishing ground which was exploited by the inhabitants of Amathus.

In addition, the construction of rock-cut fish-ponds along the northern coast of Cyprus is likely a result of the knowledge of the landscape and seascape of Cyprus (Auriemma and Solinas 2009: 136–137; Marzano 2013: 205–233; Morhange and Marriner 2015: 148–150; Evelpidou and Karkani 2018: 3; Michael 2022: 379–388). Their structural arrangement mainly consists of a pond and one or two rock-cut channels used as an entrance from the sea to the pond, while they involved human effort and required unremitting care (De Re Rus. 8.1.3). Based on the written sources, the structure of a fish-pond depends on the seabed morphology, sea level, tides, prevailing winds and currents (De Re Rus. 8.16.6–8, 8.17). This descriptive information has been confirmed by combining the archaeological remains of the fish-ponds at Lapithos, an archaeological site located on the northern coast of
Figure 3.9. Map defining the upwelling phenomenon in relation to the landward and seaward buffers of Cyprus (land and coastal zones of Cyprus) and the Hellenistic, Roman and Early Christian sites. The site of Amathus is marked with a red point as discussed in the text. Produced by the author on ArcGIS. Source for layers of Hillshade Coastline: Department of Lands and Surveys, Cyprus; a single passage NOAA-AVHRR image on 15 August 2011 from the CYCOFOS ground satellite receiving station at the Oceanography Centre of the University of Cyprus is used as basemap. This image shows the upwelling phenomenon and its offshore extension south of Cyprus (Department of Fisheries and Marine Research 2012: 11); layers of archaeological sites produced by the author.

Figure 3.10. A view of the fish-pond at the archaeological site of Lapithos, on the north coast of Cyprus. Photo by the author.
Cyprus (Figures 3.8 and 3.10), with environmental and ethnographic data (Nicolaou and Flinder 1976: 134: Fig. 1; Michael 2022: 381–386, 399).

As already discussed, the seabed of the northern part of Cyprus is more fertile in comparison to the southern part based on oral histories and traditions, while the stability of the north coast to the present sea level benefited the construction and development of fish-ponds in this area (Nicolaou and Flinder 1976; Panayides 2018: 227, 235–237). As a result, the construction of fish-ponds along the north coast of the island was a choice based on the potentially lucrative ground. In addition, the orientation of fish-ponds was intentionally chosen in order to take advantage of the incoming tide of the sea and the predominantly northwesterly to northeasterly winds (Michael 2022: 147, 379, 384). These winds create a current tending towards land, which contributed to the continuous renewal of water within the pond. Consequently, the occurrence of fish-ponds along the north coast of Cyprus is not by chance, while the daily interaction of fishers with their maritime environment led to acquiring a maritime knowledge, which in turn affected the growth of fishing.

To sum up this brief discussion, it seems that Cypriots who decided to become fishers and engaged in fishing also decided to adopt a specific lifestyle. Knowledge of ecology (seabed ground), meteorology (winds, currents, tides, etc.) and biology (availability of fish species) was an essential ‘tool’ for establishing and developing fishing. The only way to acquire this knowledge was to interact daily and systematically with the physical and cognitive aspects of the terrestrial (landscape) and marine space (seascape) in which they lived and worked. Consequently, the understanding of fishing in Cyprus diachronically contributes to understanding an important aspect of the human life of Cypriot maritime communities.

**Fishing as a way of living in the field of maritime archaeology**

To end this discussion, it is essential to address the question of how the understanding of the daily activity of fishing in Cyprus diachronically contributes to advancing the field of maritime archaeology as a way of understanding human life. To answer this question precisely, the author returns to the definition of maritime archaeology, which—in general terms—is the study of human interaction with the sea through the archaeological study of material evidence of maritime culture (Delgado 1997: 259; McKinnon 2014). Through the research presented here, the study of material related to fishing demonstrates that fishing communities relied on the accumulated knowledge of their local maritime landscape and seascape to navigate and identify fishing grounds and develop the activity of fishing.

Thus, fishing is not just the engagement of a person with the sea to catch fish; rather, it is a lifestyle because fishers interact with different aspects (e.g. environmental, biological, cultural, etc.) of their landscape and seascape in order to decide where, when, what and how to catch fish. For instance, the knowledge of the vegetation of a fishing ground, as already discussed, is an important element for the effectiveness of fishing because the presence of Mediterranean tapeweed/seagrass (*Posidonia oceanica*) within a fishing ground may be one of the main factors in the establishment and development of fishing in an area because these seagrasses are a primary source of nutrition in marine environments (Michael 2022: 428).

In addition, the knowledge of the seabed’s nature is essential for deciding whether an area is a profitable fishing ground or/and the right point to use a specific fishing gear or/and fish the targeted fish species which fishers want to catch (Acheson 1981: 276–277, 290–291, 307; Aswani 2020: 475–479, 481; Michael 2022: 428). According to the oral Cypriot tradition, fishers used heavy rocks covered on their bottom with animal fat (Michael 2022: 219–220). They threw them on the seabed and after a few minutes pulled them up. If sand stuck on the animal fat, it meant the seabed was sandy and not rocky, so it was a good area for setting up nets. These heavy rocks that Cypriot fishers used to identify the morphology of the seabed seem to be similar to ancient stone or lead sounding weights, which have been mainly found in Israeli waters and can be seen as auxiliary to fishing activity (Oleson 2000, 2008: 120–121; Galili and Rosen 2008: 72; Galili 2010: 133; Galili et al. 2013: 154–157; Safadi 2018: 240–241). Only three have been recorded from ancient Cyprus (Oleson 2000: 299, 2008: 146, 154, 157). Although their usage is similar to the stone that Cypriot fishers used, sounding weights are not mentioned as fishing gear, but they are interpreted as navigational tools used to identify the morphology of the seabed during a sailing trip (Oleson 2000: 295–296, 2008: 125–129; Galili and Rosen 2008: 75). Consequently, combining the traditional use of heavy rocks to distinguish the seabed’s nature with archaeological evidence of sounding weights from the wider region of the eastern Mediterranean suggests fishers interacted with its marine environment in order to acquire knowledge about the morphology of the seabed.

Finally, fishers, like all seafarers, pay constant attention to some points of orientation to locate their fishing grounds, especially when there are currents or it is windy (Frost 2000; Morton 2001: 203; Obied 2016: 9–11, 36–38, 64, 145–158; Safadi 2018: 239–241; Michael 2022: 218–219). Based on oral traditions, Cypriot fishers watch a fixed landmark or a pair of landmarks—for example, a church, a distinctive elevation or familiar mountaintop and/or promontory—and observe how the landmarks look from their boat to enable them to know their present position (Michael 2022: 429). In the same way, the ancient promontory shrines/temples of Phoenicians, Greeks and Romans would have been visible to seafarers and fishers moving along the coast, acting as key navigational markers in the mental maps of their environment (Semple 1927: 379). In addition, Strabo describes how seafarers used the mountains Amanus, Rhosus and Pieria to sail south along
the rocky seascape of the Northern Levant (Obied 2016: 148). Consequently, it seems fishers attempt to perceive, interact and use their landscape and seascape in order to acquire knowledge (a mental map) of their landscape and seascape, which is important for establishing and developing fishing.

Thus, the effectiveness of fishing depended on the constant interaction of fishers with their landscape and seascape, while this constant fisher-sea interaction led to the acquisition of knowledge of their landscape and seascape, an intangible aspect revealed through the simultaneous study of archaeo-ichthyological and contemporary/traditional evidence (Michael 2022: 428). Through this systematic and simultaneous examination, it is possible to comprehend the nature and synthesis of fishing and how and why it was established as a social and cultural action in various archaeological contexts over time. Consequently, the contribution of the study of fishing through time is essential to advancing the field of maritime archaeology as a way of understanding human life.

Conclusion

This chapter explores and interprets the human utilisation of space through the daily activity of fishing in the archaeological context of Cyprus through time. Through the concurrent study of archaeo-ichthyological evidence with the environmental and cultural characteristics of their archaeological context, the reconstruction and comprehension of fishers’ knowledge of their known local environment (mental map) is accomplished. By using the ethnoarchaeological approach, it is possible to reveal this intangible knowledge, which in turn can determine the occurrence or absence of fishing in the Cypriot maritime landscape and enable hypotheses about the relationship between fishers and their maritime environment in the past.

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Ropotamo: an Early Bronze Age pile-dwelling on the Western Black sea coast

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Abstract: Ropotamo is a multi-period archaeological site located on the southern Bulgarian Black Sea coast, in a small bay where the Ropotamo River flows into the sea. Due to the unique natural habitat, the site has preserved the stratigraphy left by millennia of human activity in the bay. In 2017, underwater archaeological excavations were launched as part of the international Black Sea Maritime Archaeology Project (Black Sea MAP). Over the following seasons to 2020, four trenches were excavated. Documentation was primarily done with a multi-camera rig for high-resolution digital photogrammetry, and interdisciplinary analyses were carried out. At depths between 1.5 and 2.0 m below seabed, artefacts from the Early Bronze Age were discovered: pottery, flint, stone, bone tools and wooden piles of structures. Detailed analysis of the stratigraphy shows that when the sea level was c. 6 m lower than the present one, a pile-dwelling settlement was established. The structures were raised on posts near or on a calm freshwater environment such as a river or a lagoon. Radiocarbon dates the site to the very end of the fourth millennium BC. The settlement’s inhabitants relied more on hunting than husbandry and were forced to make repairs as the sea level rose, until they eventually abandoned the site.

Introduction

In 1921, when digging for a navigable channel connecting two coastal lakes in the area of Varna, the remains of a prehistoric settlement were found below sea level at a depth of between 3.0 and 4.5 m. In the following decades, the number of known settlements increased, and to date, we have data on over 20 underwater prehistoric sites along the Bulgarian Black Sea coast (Ivanov 1993; Draganov 1995, 1998). Most of them date to the Late Chalcolithic and Early Bronze Age (fifth–fourth millennia BC) and are concentrated in two zones: north in the waters of Varna and Beloslav Lakes and in coastal marine bays south of Burgas. Although more than a century has passed since the discovery of the first settlement underwater, only a few of these settlements have been researched archaeologically. Therefore, the study of the archaeological site in the bay in front of the mouth of the Ropotamo River (Figure 4.1) deserves particular attention (Dimitrov et al. 2020; Ballmer et al. in press).

The Ropotamo River is typical for the southern Bulgarian Black Sea coast: small and almost drying up during summer in the upper reaches but, at the same time, wide and navigable year-round in the last 8.5 km for vessels which draw up to 2.5 m. Typical for Ropotamo and other rivers of the Bulgarian coast (for example: Kamchia, Karaagach and Veleka) is that the estuary is blocked by a sand bank, which closes and opens depending on the winds and the amount of rainfall. These characteristics cause the development of a lasting brackish or freshwater marshy area at the mouths of the rivers, the level of which can rise by more than a metre with a strong east wind and heavy rain in the area.

The bay into which the Ropotamo River flows is about one kilometre wide. From the north, it is closed by a semi-submerged rocky reef with a length of about 200 metres, and from the east by a small sandy and pebbly beach. Due to its specific location, orientation and shape, the bay in front of the mouth of the Ropotamo River is one of the best protected natural harbours on the Bulgarian coast (Figures 4.1.3 and 4.1.4). These exceptional conditions for docking, including wintering, combined with access to the rich and diverse natural resources of the hinterland, have been attracting people to this place since very ancient times.

Underwater archaeological research in the bay at the mouth of the Ropotamo River

Surveys 1973–1989

Underwater studies in the bay began in 1973 and continued with several interruptions until 2020. Until 1989, the leader of the excavation was Prof Ivan Karayotov from the Archaeological Museum in Burgas. In 1989, the last archaeological season directed by Prof Karayotov, an archaeological trench was excavated in a small area; under a layer of mixed archaeological materials (mainly ceramics from Antiquity and the Middle Ages) and a dense mussel layer, prehistoric materials were found: wooden piles fixed in the bottom, burned clay plaster fragments, sharpened and whole pottery vessels, grinding stones, bones, flint, stone,
Figure 4.1. Location of the Ropotamo archaeological site. 1, Location of the site on the Western Black Sea coast. 2, Location of the archaeological trenches in 2017–2020 on a bathymetric map. 3, Topographic map of the area of the lower course of the Ropotamo river; a 1:25000 map was used as a base. 4, Arial view from SE of the Ropotamo river mouth and the bay in front of it. Maps compilation by K. Dimitrov.
bone and antler tools. These finds were recorded at a depth of c. 2.0 m into the bottom, which means a depth of c. 5.5 m below the sea surface. The finds are dated by typology to the first stages of the Early Bronze Age (EBA). Karayotov’s studies were interrupted after 1989, but in several publications in the following years, based on numerous finds, he summarised his observations about the studied site, which he defines as a ‘sunken harbour’ and ‘sunken prehistoric settlement’ (Karayotov 1990, 1992, 2002).

Surveys 2017–2020

Methodology of excavation and documentation

In the period between 1989 and 2017, archaeological excavations were not conducted, but Ropotamo remained an important site on the map of submerged prehistoric settlements along the Bulgarian Black Sea coast. It remained of great interest because, unlike all other known settlements of this type, this site has not been affected by development or destroyed by large-scale dredging or other anthropogenic activities. This is why in 2017, the prehistoric settlement was selected for underwater archaeological excavations within the framework of the international Black Sea Maritime Archaeology Project. The goal of the excavations was to explore, using modern methodology, the submerged prehistoric settlement in order to shed light on changes in sea level, the changes in the environment and the human response to this evolution. In this way, environmental and archaeological data from Ropotamo would be complementary to the sea-level change data acquired by the Black Sea MAP deep water surveys on the Bulgarian Shelf acquired 2015–2017 (Sturt et al. 2018). During the four years of work, two sectors lying 25 m apart were studied; these were labelled T1–T2 (later T2–T3) and T4. In total, an area of about 100 m² was studied. The excavation was carried out in layers of about 10 cm or by stratigraphic units. Sediment removal was effected with water suction dredges operated by divers. Each revealed level was documented by underwater digital photogrammetry and photographic and video records. At the conclusion of each of the two sectors (T2–T3 and T4), samples of the profiles were collected to carry out sedimentary, palynological and archaeobotanical analyses. The stratigraphic layers were dated by typological determination of the artefactual and structural material and by radiocarbon dating of wooden and other organic remains (Вагалински et al. 2018; Димитров et al. 2019, 2020, 2021).

The photogrammetry survey at the site was carried out according to the specifics of the Black Sea and the archaeological site, whose conditions would require some ingenuity. First of all, visibility is usually much lower than in other seas worldwide, even more so for a site located close to a river mouth. For this reason, a rig of several action cameras was used. Every camera was mounted to shoot at a different angle to ensure sufficient overlap of 60–80%, which is essential for a successful photogrammetry model. For the first two seasons at Ropotamo, a specially designed rig to mount five GoPro 7 Black was employed, which gave very good results even in visibility less than 50 cm (Pacheco-Ruiz et al. 2018). The drawback was this technique accumulates a very large number of frames, which require a lot of computational power and time to process. Because of this, since 2019, a custom-built frame for just three action cameras was used, which drastically reduced the number of images per survey. This allowed for the completion of daily recordings of the archaeological site and the construction of ready model for the next day.

Surveying a trench in the seabed for photogrammetry is a challenge in itself. It requires sufficient overlap of the images connecting the ground control points or markers; these are fixed on the seabed with the archaeological situation, which can be up to 3 m below seabed. For this, a new survey pattern was applied, one which combines the spiral pattern used by Pacheco-Ruiz et al. (2018: 124, Fig. 7 b) and the transversal and longitudinal path presented by Yamafune et al. (2016: 12, Fig. 12). To increase local accuracy, 4×1 metre-scale bars or smaller were always placed in the survey area, which minimised the error to 1.5 mm per 1.0 metre. The models were georeferenced by four coded markers, the coordinates of which were taken with a differential global navigational satellite system (GNSS) with a real-time kinematic correction.

Taking precise global coordinates on an underwater site has always been a challenge, especially in deep water, because the signal from the satellites cannot penetrate through the water’s surface. Fortunately, the Ropotamo site is at a relatively shallow depth and can be measured by just using a 5 m-long pole to keep the transceiver of the signal above water, a method which has been widely used in recent years (Pacheco-Ruiz et al. 2018: 125; Reich et al. 2021). Coupled with the millimetric intra-site accuracy noted above, this fixes the position of the trench and every object in the model down to 2 cm of global accuracy.

Since in the Ropotamo project the spatial positioning of the sectors was carried out with a GNSS receiver, the depths below sea level discussed in the actual text are relative to the Baltic geodetic system, which is the standard used in Bulgaria. The real depths, measured on the site with a depth gauge or tape measure, differ from the geodetic ones by up to 20–25 cm. The difference is variable and depends on the tides, which, although small, still exist in the Black Sea.

Before images were loaded into a photogrammetry software, they were first processed with the open-source software RawTherapee. This software provides a fast and easy way to make corrections without affecting the quality of the original image: the white balance has been corrected on all the photos to remove the loss of colours due to the water environment and reduce the resolution to half, as for our purposes, 4k is too much. For the photogrammetry processing, the software Agisoft Metashape was used with a standard workflow (Agisoft LLC 2023), with additional
processing steps to clear any interference added by the water environment.

From the photogrammetry model, we export a high-resolution orthomosaic and a digital elevation model. These were used to create a detailed site plan in a vector graphics editor software such as Adobe Illustrator. There the archaeological finds are outlined in standard colours based on their material of manufacture. Stratigraphic changes in the sediments can be visualised with the exact coordinates and depths of any samples taken for further analysis. Furthermore, from the photogrammetry model, we can create animations to better visualise the archaeological situation for the general public.

**Stratigraphy of the archaeological site of Ropotamo**

In 2017, a complex marine geophysical survey was conducted, and underwater excavations were started within two standard archaeological squares of 5×5 m (T1 and T2). In 2018, the excavation area was increased by a new square of 5×5 m, marked as T3, positioned on the north side of T2. During the excavation in 2018, the excavations in T2 and T3 were connected and shaped as a stratigraphic trench T2–T3. The survey in 2019 and 2020 focusses on square T4, which lies 25 m to the northeast of T3 (Figure 4.1.2).

The stratigraphic observation in T2–T3 and T4 are similar, although not identical, and they present some differences in the thicknesses of individual layers (Figure 4.2). In both sectors, five stratigraphic layers have been established:

- **Layer 1:** At the top, a layer of marine sediments has been studied, which was formed when the bay was used as a harbour. It contains a large number of archaeological materials, mainly ceramics, which were deposited in a recognisable chronological sequence from the Late Archaic to the Late Ottoman period. The chronological and that quantitative analysis of the finds in this layer shows that port in the bay in front of the mouth of the Ropotamo River began to be used with the arrival of the first Greek colonists along the western Black Sea coast at the end of the seventh century BC, and it experienced prosperity during the Roman and Late Roman time. The discovered amphorae and table vessels are imported and originate from different parts of the Mediterranean. The complexity of the archaeological materials of this layer very well illustrates the periods of economic prosperity and crises on the western coast of the Black Sea.

- **Layer 2:** Under the port materials is a layer of marine sediments in which no archaeological finds are found.

The layer is characterised by a large amount of large mussels and oyster shells. This layer represents a cultural hiatus and was accumulated in a period when there were good conditions for mollusc development in the bay: quiet and warm water, rich in nutrients. Chronologically, this layer was accumulated between the third and first millennia BC. Its formation is also associated with a rise in sea level over this long period.

- **Layer 3:** Under the ‘hiatus’ layer in an environment of marine sediments are found the remains of a settlement from the Early Bronze Age (EBA): fixed wooden piles of building structures oriented vertically or at an angle, pieces of burned clay plaster, pottery, antler, bone, stone and flint tools. The EBA layer also contains faunal remains, most likely related to nutrition.

Archaeological finds and materials from the EBA are found unevenly distributed in this layer from c. –4.55 m to c. –5.50 m below modern sea level in sector T4 and between c. –5.00 m and c. –5.65 m in sector T2–T3 (Figure 4.3). Apart from the wooden piles which are still fixed in place, the other finds are not found in situ in the proper sense of this term. The observations (mainly in the trench T4) of the stratigraphic distribution of the individual categories of findings, however, allow for some conclusions concerning the construction of buildings and the stages of their operation and destruction. The buildings are erected as pillar structures with horizontal wooden platforms with a clay coating (Figure 4.4). The vertical wooden piles are carefully sharpened and driven into the terrain by digging and hammering into two layers (4 and 5) on top of which the EBA settlement is built.

During the habitation of the settlement, a change in the dynamics of the coastline occurs, and the accumulation of marine sediments between the piles begins. The process is relatively slow; probably at the beginning, it seemed episodic and allowed the inhabitants to carry out repairs and other reinforcement activities to the wooden pile structure. The rise of the sea level and the entry of marine sediments into the boundaries of the settlement continued until the point the site had to be abandoned. Later, the site was completely destroyed and covered by marine sand. It is difficult to estimate the speed of flooding and the absorption of settlement’s remains by the sea, but the good preservation of the wooden piles and the archaeological finds suggest the process is relatively fast, and the rise in the sea level of c. –5.50 m to c. –4.55 m occurs before the wood had time to rot and probably lasts no more than 100–200 years.

- **Layer 4:** Particularly interesting and important for understanding the changes in the environment during the Bronze Age is the layer lying at c. –5.6 m to c. –5.7 m below modern sea level, on which the settlement is built. In T4, it is a grey silty layer formed in a freshwater environment (Figures 4.4.2 and 4.4.4), and in T2–T3, it is a naturally lithified surface of a coastal sand dune. It is on these levels, which once marked the ancient coastline, people first chose to settle by digging and driving into them the wooden piles for the construction
of their buildings. Settlement close to the sea level is possible only because the EBA settlement is located not on an open seashore, but on the right bank of the ancient river Ropotamo, not far from its mouth. The place of EBA habitation was probably very similar to the modern landscape which the Ropotamo River has formed along its left bank in the last two hundred metres of its course (Figure 4.1.4).

- **Layer 5:** Below the level of construction in T4 is documented a layer of dense dark yellow, yellow-brown clay, which has a preserved characteristic of a terrestrial soil. In 2020, during a final control trench in this sector, reaching a depth of –6.7 m below modern sea level, several fragments of handmade pottery were found. Their surface is well preserved, and the graphic reconstruction of the forms showed parallels with vessels from the Late Neolithic, the most direct being those from the site Aşağı Pınar 3. Since during the underwater studies of Ropotamo, no archaeological structures have been found which have such an early date, the presence of these single materials from the end of the sixth millennium BC should be explained by the existence in the near vicinity of a still to be located earlier prehistoric settlement, which predates by about 2000 years the occupation of the EBA.

Below the level of BA materials from sector T2–T3 to a depth of –7.9 m from modern sea level is documented a layer of homogeneous white, fine and uniform sand, with no archaeological finds. There are no shells of marine molluscs in this layer, and it is most likely a flooded ancient coastal dune.

### Findings

The great majority of prehistoric finds from Ropotamo belong to the EBA layer. The exceptions are the few fragments of ceramics, for which an earlier date has been proposed.

The EBA pottery from Ropotamo is handmade and relatively roughly: there is often a lack of symmetry in the forms, and the clay is coarse with inorganic, crushed shells or fine organic temper. The pottery has a severely eroded surface, which is probably due to poor initial firing, the secondary accidental fire at the destruction of the site and its deposition in a layer of mobile marine sediments. The percentage of whole vessels is relatively small, which distinguishes the collection from Ropotamo from the finds from other submerged settlements on the Bulgarian Black Sea coast. About 50 whole profiles were recorded (Figure 4.5). Most well-preserved vessels are small or medium in size, and large vessels are highly fragmented. Twelve categories of vessels are distinguished: dishes, bowls, jugs, askos, cups, amphorae, pots, containers, lids, ladles and strainers (Figure 4.5). The most common categories of vessels on the site are pots, bowls and jugs. Important for the chronology of the site is the record of askos in the ceramic repertoire (Figures 4.5.19 and 4.5.25), which suggests an earlier date of the complex to the EBA 1 stage.

A small number of the vessels are decorated in a manner typical for the period: stamped, incised, corded, cuts, embossed strips, relief buds and finger pits (Figures 4.5.1–4.5.4, 4.5.8 and 4.5.15). Corded and incised decoration are rare, mainly on the finer vessels (Figures 4.5.1 and 4.5.2).
but they are important as a chronological indicator for the beginning of EBA 2.

The ceramic complex of the EBA settlement at the mouth of the Ropotamo River finds parallels with the other submerged EBA settlements along the Bulgarian Black Sea coast—those at the Varna Lakes, Burgas, Sozopol, Urdoviza and Atia, the closest being those with the settlement in the harbour of Sozopol. Unfortunately, none of the ceramic complexes of these underwater sites is fully published, but based on the known finds, some general conclusions can be drawn.
Figure 4.4. Underwater archaeological research in sector T4. 1. Excavation with a waterjet on wooden posts in sector T4. 2–4. Documented stratigraphic situation showing how piles from sector 4 were dug into layers 4 and 5. 5. Wooden piles in sector T4; axonometric view from S. Photos by K. Dimitrov; 3D modelling and axonometric view by P. Georgiev.
Figure 4.5. Early Bronze Age pottery from the site Ropotamo. Drawings and photos by Hr. Vassileva.
Among the finds from the Varna Lake settlements Ezerovo I, Ezerovo II, Stashimiriovo I and Stashimiriovo II, almost all types of vessels found in Ropotamo have parallels. Similarities are found in the shape of plates and bows (Маргос and Тончева 1962: Fig. 11; Маргос 1973: Fig. 5/1–5; Иванов 1973: Table V/1–9; Тончева 1981: Fig. 18/3–8, 19, 20); jugs, cups and askoi (Маргос and Тончева 1962: Fig. 5; Маргос 1973: Fig. 5/11–15, Table VIII/1–3; Иванов 1973: Table IV/3–5; Тончева 1981: Fig. 7–11); pots and amphorae (Маргос and Тончева 1962: Fig. 6/1–4, 7; Маргос 1973: Table IX/1–4; Иванов 1973: Table V/15–17, 19; Тончева 1981: Fig 16, 21, 22). The incised and corded decorations from Ropotamo are similar to those found in Ezerovo I (Маргос и Тончева 1962: Fig. 8, 9), Ezerovo II (Тончева 1981: Fig. 12–14), Stashimiriovo I (Маргос 1973: Tables VIII/8–12, IX/8–14) and Strashimiriovo II (Иванов 1973: Table V/18, 20). The decoration found in Ezerovo II is dominated by corded and incised ones. Comparing with Ropotamo, a difference in the amount of these types of decoration is clearly discernible. The small amount of corded decoration from Ropotamo indicates this site should be dated earlier than Ezerovo II. On the other hand, there are clear similarities with Ezerovo I in the ceramic shapes, the decoration and probably in the chronology as well.

When the shape and decoration of the ceramics from Ropotamo are compared with the finds from the southern Black Sea coast, parallels can be noted in the forms of jugs, cups and askoi from Burgas (Димитров et al. 2020: Fig. 7), as can similarities with plates, jugs, cups, pots and amphora found in Atia (Димитров et al. 2020: Fig. 9).

The ceramic complex from the Kiten–Urdoviza is the best represented in the literature, and this allows the most well-argued typological and chronological comparisons with Ropotamo. Parallels can be found in all types of pottery: plates and bowls (Лештахов 1991: T I, T II; Драганов 1995: Fig. 4/2, 4, 6, 6/1; Ангелова and Драганов 2003: Fig. 5/1, 2, 13; Василева 2018: Fig. 4/7–12); jugs, cups and askoi (Лештахов 1991: T VI, T VII/1–6; Ангелова and Драганов 2003: Fig. 6/2, 3, 5–13; Василева 2018: Fig. 5; Димитров et al. 2020: Fig. 41/1–8, 10, 11); pots and amphorae (Лештахов 1991: T III, T IV, T V; Драганов 1995: Fig. 3, 5/15–17, 6/2, 5; Ангелова и Драганов 2003: Fig. 5/5–11, 14–17; Василева 2018: Fig. 6/6–8; Димитров et al. 2020: Fig. 42/8). The cord and incised decoration is one of the main characteristic of the ceramic complex from Urdoviza (Лештахов 1991: T IX; Ангелова и Драганов 2003: Fig. 4) as a contrast to the Ropotamo repertoire. This fact points to the likely earlier dating of the Ropotamo settlement.

Parallels with the ceramic finds from Ropotamo are found with those from the submerged settlement in the harbour in Sozopol: plates and bows (Драганов 1998: Fig. 5/2, 3, 9, 10, 14; Василева 2018: Fig. 3/2; Димитров et al. 2020: Fig. 26/4–9); jugs, cups and askoi (Драганов 1998: Fig. 4/12, 5/5–7, 11, 12; Клазнаков и Стефанова 2009: Fig. 1, 2; Василева 2018: Fig. 3/3, 4; Димитров et al. 2020: Fig. 26/2, 27/2–13), pots and amphorae (Драганов 1998: Fig. 5/8; Василева 2018: Fig. 3/7, 8; Димитров et al. 2020: Fig. 26/1, 10–12). Both the types of the vessels and the incised and corded decoration patterns are closest between these two settlement compared to the other submerged sites (Драганов 1998: Fig. 5/1–3, 10, 11).


The main conclusion from the detailed presentation of the typological pottery parallels with other coastal and inland sites is the Ropotamo pile dwelling represent a specific initial phase of Early Bronze development which nevertheless remains within the traditions of the eastern Balkan Early Bronze cultures of Cernavodă and Ezero type.

The 11 pieces of ceramic fragments in the control trench from sector T4 found in the fifth stratigraphic layer differ from the ceramics described above and have a well-preserved finely worked surface (Figures 4.6.1–4.6.5). From this scarce material can be partially reconstructed three vessel shapes (two cups and one bowl), which find the most direct parallel with finds from Layer 3 of Aşağı Pınar (Парзен и Шварцберг 2005: 63, 69, 149, 229). In the periodisation of the Neolithic in Thrace, this means Karanovo III/IV or the beginning of Karanovo IV (после Николов 2003), and along the Danube the Vinca complex. If this preliminary relative and determined only by typology date is confirmed in the future, it means the Ropotamo site has materials from the end of the sixth or the very beginning of the fifth millennium BC, referring to the Late Neolithic (the end of the Karanovo IV period).

The wooden artefacts from the site can be attributed as elements of structures. In total, 83 elements are recorded: 19 in T2–T3 and 64 in T4. Of the total, 75 are posts or piles, five could be categorised as laths and the horizontal beams or joists are just three. On one of the latter elements, a carved joint was recorded. The wood is in different states of preservation, which is most probably linked to its species. The main tree types are oak (Quercus sp.) and ash (Fraxinus sp.), with a small number of other genera. All the posts have their tips sharpened, and on those in better condition, the traces of tools and partial burning, probably for fire hardening and endurance, could be seen. Their diameter ranges 7–23 cm and their preserved length from 48 cm to 1.40 m. Of all the discovered piles, only
Figure 4.6. Finds from the Roptamo prehistoric site. 1–5, Neolithic pottery from sector T4. 6–10, Antler tools. Photographs and drawings by K. Dimitrov. 11–21, Chipped stone artefacts: 11: nodule with unifacial removal; 12, 14–16, 17 and 19: splintered pieces; 18 and 20: blades; 13 and 21: retouched blade used as sickle insert. Photographs and drawings by M. Gurova.
11 had their bark, which could be evidence of intentional stripping. Only two laths have a rectangular cross-section, and several posts could have had one or two of their sides worked. Ten of the wooden piles were intentionally split longitudinally in half, and three were of quarters; the rest were used as a whole trunk.

Most of the piles are found in a vertical position and are from a straight section of the tree. A small number are either curved or slanted. The first is due to the natural curvature of the tree, and the others are the result of the construction with elements at an angle or by a deterioration after abandonment of the settlement.

The collection of prehistoric tools from the Ropotamo site is small and modest, but it contains almost all categories typical of EBA objects: grinding stones, hammers, blades, a socketed antler axe collar, flat stone axes, fragmented, socketed stone hammers, bone awls, etc. (Figures 4.6.6–4.6.10). Among the finds, a fragment of a clay metallurgical crucible should be noted. Its presence in the settlement can be associated with the well-known copper deposits of Medni Rid, lying about 12 km northeast from the site.

The knapped stone assemblage from Ropotamo (seasons 2019–2020) is very interesting and comprises 171 artefacts. A proportion represents nodules (most of them black, compact and opaque) with an ovoid-ellipsoidal shape and lengths between 3.0 and 4.8 cm. The nodules were subjected to splintering techniques/bipolar reduction by direct percussion using a hammerstone, with the nodules placed on a stone anvil (Clark 1953; Shott 1999). This technique results in various splintered pieces and rare typical blanks (flakes and blades).

The assemblage contains 34 pseudo-artefacts, four atypical flake cores, 27 nodules with uni- and bifacial removals (Figure 4.6.11), 48 flakes (16 entirely cortical, 24 with partial cortex and eight without cortex) and 18 fragments (10 of flakes and eight undetermined). There are 31 uni- and bifacial splintered pieces, of which 15 were on dimidiated nodules (Figures 4.6.12, 4.6.14–4.6.16); eight on blanks (Figures 4.6.17 and 4.6.19) and eight on fragmented nodules. Separately, there is a small series of blades (four examples), three of which were removed from blade cores (Figures 4.6.18 and 6.20). Apart from splintered pieces, there are five other typological tools, four of which are on blades—three endscrapers and one retouched blade (Figures 4.6.13 and 4.6.21); there is also one backed tool on a kombewa flake.

Use-wear analysis of the blades, the five tools mentioned above and a small series of splintered pieces, allowed the identification of five artefacts used as sickle inserts (Figures 4.6.13 and 4.6.21). There are two tools (an endscraper and a backed tool) with microchipping and undiagnostic polish spots, indicating the cutting of hard material which cannot be identified more precisely.

The presence of standard blades and tools on blades cannot be linked to the application of the splintering technique as part of the on-site chaîne opératoire. The blades indicate the importation of blanks of a standard type which can plausibly be linked to the particular domestic needs of the EBA community which inhabited the site.

During the archaeological excavation of the EBA layer in the sectors, T2–T3 and T 4, a collection of a total of 120 animal bones was accumulated. Of these, 87 fragments are defined as species: red deer (NISP 35), cattle (NISP 17), bones of small ruminants (sheep, goat) (NISP 4), domestic and wild boar (NISP 16), roe deer (NISP 1), fox (NISP 1), fallow deer (NISP 7) and fragments of tortoise shells (NISP 2). The ratio of domestic to wild is in favour of wild animals, which accounted for 69% of the total material. Of note, most of the bones and horns belong to red deer, with the remains almost double those of cattle, which is not typical for this period. Deer antlers (noble (red) and fallow deer) were mainly used as raw materials for tools (Figures 4.6.6–4.6.10). For this purpose, antlers already shed in the forest were collected, but those separated from the animal when it was killed were also used.

The cattle’s remains are mostly from the upper and lower jaws, but there are also fragments of the pelvis and lower extremities. Only one bone belongs to the auroch (Bos primigenius): a distal part of a large tibia. Of the small ruminants, the remains are also very few—mostly jaws and two teeth of individuals in adulthood. Most of the remains of pigs are from wild boar (Sus scrofa), while only one jaw and phalanx have been found from a domesticated one. Other single finds are the fragments of bones from horse and fox.

Most of the material in the collection belongs to adult animals over two years, but there are also single fragments of young animals—red deer, wild and domestic pigs, and cattle. All the bones were burned at high temperatures (above 500 C°), most likely along with the layer in which they were found.

The identified species of wild and domestic animals are typical for the period and the area. Red deer and fallow deer have been the most hunted animals since the Late Chalcolithic period (Spasov and Iliev 1994). Fallow deer remains drastically decreased during the Early Bronze Age, but are still found in small numbers at sites in the coastal strip such as Urdoviza (Ribarov 1988; Spassov et al. 2018) and Sozopol (Ribarov 1991). The archaeozoological collection from Ropotamo is characterised by a large percentage of wild animals (69% of the total material), which is similar to that of the sunken settlement in the harbour of Sozopol (Ribarov 1988; Spassov et al. 2018). The presence of a large number of horse bones from this period in the site of Urdoviza is described by Ribarov and Spasov (Ribarov 1988; Spassov et al. 2018), but during the excavations of Ropotamo, only one fragment of a scapula was found, although it is difficult to identify to which species it belongs. According to Spasov, in Urdoviza,
‘horses belong to Equus germanicus, a broad-hoofed horse and are a domesticated species’ (Spassov et al. 2018: 14). The bone found at the Ropotamo site may belong to same species, but this cannot be precisely determined.

The faunal material shows that in the Ropotamo region, the climatic conditions in the EBA were similar to those of today, as these wild animals are characteristic of today’s habitat. The presence of fallow deer shows a relatively warm and mild climate in the region and mixed forest comprising a mosaic of dense deciduous stands interspersed with open clearings and meadows. The large percentage of bones of wild animals, as well as the age and species composition of the osteological collection of the EBA layer, suggest an economy of the inhabitants in which hunting had a very important place.

Radiocarbon dating

Samples for radiocarbon dating were taken throughout the four seasons of excavation. In total, there are 15 14C dates. One is from a carbonised wheat ear (Triticum) found in T2, and all the rest are from vertical wooden piles (Figure 4.7). The latter were selected based on stratigraphy and the number of tree rings, with a preference for piles with more annual rings and the possibility for wiggle-match modelling. Samples were measured at the Scottish Universities Environmental Research Centre AMS Laboratory and calibrated to calendar timescale using the Oxford Radiocarbon Accelerator Unit calibration programme OxCal 4.4 (Bronk Ramsey et al. 2001; Dunbar et al. 2016).

From sectors T2–T3, there is one sample from pile P 0, four from P 03 and another four from P 07. Accordingly, from sector T4 are two samples from pile P 21 and three from pile P 67. As seen from the result, the dates can be put into three groups: the oldest from pile P 67 which is around 3300–3200 cal BC; the second group from piles P 0, P 03 and P 07 are set around 3100–3000 cal BC, and third and youngest from the wheat ear set around 2900–2800 cal BC. The dates from pile P 21 are uncertain with 45.4% for 3291–3203 cal BC (95.4% probability) and 44.0% for 3066–3013 cal BC (95.4% probability), which means it can fall either to the first or second group of dates.

As for the youngest date from the site (SUERC-108102, wheat ear Triticum), we must view it with caution, as the dates from it are too broad (2906–2702 cal BC with 95.4% probability) for a definitive conclusion. Nevertheless, they are coherent with the known general chronology of the site and fit within the EBA.

Based on these results, we can conclude that the excavated section of EBA settlement in Ropotamo could have two building phases: one set around 3300–3200 cal BC and the second around 3100–3000 cal BC. However, the calibration curve for the period 3300–3100 BC is not categorical and allows for the interpretation of the dates in one phase. However, while the 14C dates may represent either two distinct periods of construction or a more or less continuous period, the presence of two phases with a small time gap between them is also suggested by the analysis of the pottery, which shows vessel forms considered diagnostic for the first phase of the EBA (the askoi), as well as a decoration technique (corded ware) associated with the second phase of the EBA.

The discussion here revolves around the dates from pile P 21. If we consider it to be part of the first phase, then we have a situation where sector T4 is from the first phase and sectors T2–T3 are from the second phase. If pile P 21 is part of the second phase, then we have a more complicated situation where in sector T4 are building elements from the first and second phases overlapping each other. It must be pointed out the tip of pile P 21 does not penetrate Layer 4, and pile P 67 is dug in Layer 4 and penetrates deep into Layer 5. After the study of the dendrochronological samples is completed, perhaps this dilemma will be resolved.

Main results

Underwater archaeological excavations in the bay near the mouth of the Ropotamo River began 50 years ago, making them the longest-term such project in Bulgaria. During these decades, several teams of researchers were sequentially involved, and methodologies of research, excavation and documentation were developed and improved. The final stage of the study took place between 2017 and 2020. It began with a heightened interest and focus on the remains of a settlement from the Early Bronze Age, registered back in 1989, but after four seasons of work, it is clear there is also a contribution to the overall study of the complex underwater archaeological site of Ropotamo. The 2017–2020 study can be considered as a completed stage from which a historical account of people’s lives for over 7,000 years can be deduced.

At the beginning of this period, there are modest finds which date back to the end of the Neolithic (the end of the sixth millennium BC). In addition to the fact these materials are the earliest ever found underwater in the Black Sea, they were discovered in a terrestrial layer which today lies below modern sea level.

The well-documented archaeological situations at Ropotamo for the first time provide detailed information about the construction, existence and death of EBA buildings which we find underwater today.

It was discovered that in T4 the wooden piles of the structures were fixed by digging through a grey, sticky alluvial clay layer in order to fix and secure them in the much more stable clay layer beneath it (stratigraphic description Layer 4 and Stratum 5, respectively). The piles are fixed only with grey clay, and there are no marine materials (sand and mussels) in it. This means that during the construction, Layer 4 was free of marine sediment, and this prehistoric surface was directly accessible to humans. These observations and the topographic peculiarities of the area make it possible to describe quite accurately...
Figure 4.7. 14C dates from the EBA layer of the site and their wiggle matching model. Date compilation by P. Y. Georgiev; calibration with OxCal 4.4 by R. Krauß.
the environment where the settlement from the EBA was constructed: not far from the right bank of the Ropotamo River, in an area outside the direct impact of the sea, probably on periodically flooded terrestrial terrain or in a shallow firth (a long, narrow indentation of the seacoast) of variable level, on which the river had deposited freshwater alluvium.

During the excavation of T 4, it was found that in the time of the existence of the settlement, the space between the piles began to be filled with marine sediments (large mussels, sand and stones), which gradually covered the grey alluvial layer. It was not a steady process and took place in many stages during the continued habitation of the settlement. Evidence of this are whole and fragmented pottery and other archaeological finds situated at different depths in the stratigraphic Layer 3. We believe the appearance of marine sediments in a place they did not exist when the buildings were constructed, was due to a change in the balance between the river level and the sea level which occurred during the habitation of the settlement. The advent of marine sediments to the settlement was probably at first only after the strongest storms. This forced the inhabitants of the settlement to carry out several repairs which have been documented: the installation of additional supporting piles, some of which are fixed only in the marine layer and supporting wooden piles with medium-sized stones. Attempts to preserve the buildings in the face of the advancing sea were clearly not successful because at some point, the inhabitants left. The abandonment of the settlement was probably organised, as in the archaeological finds from the EBA, there is not a single prestigious or cult or other object which we can define as valuable and important for the people of the Bronze Age.

The detailed study of the remains of the settlement from the EBA provides new data to a long-debated question in archaeology: whether the prehistoric settlements underwater along the Black Sea coast were pile dwellings or built on land and later flooded. The stratigraphy of Ropotamo and the distribution of finds and archaeological materials in Layer 3 give several arguments for the pile dwelling construction of the settlement. At the top of this layer are concentrated all the fragments of burned wall and/or floor plaster which have been found. Almost on the same level were found two large grinding stones, as well as several horizontal wooden elements. These categories of finds are associated with the level of habitation, which in this case will be on a platform about one metre above the terrain on which the settlement was built (Layer 4). The second argument for the presence of an elevated construction is the discovery of several relatively large and well-preserved vessels, as well as other finds which lie in the middle part of Layer 3. Our explanation is they mark the intermediate stages of partial filling of the space under the construction before the abandonment of the settlement. The third argument for the pile construction is the location of the settlement itself. It is near the river and on a sedimentary layer in a riparian zone. Knowing well the large amplitudes of the level of the Ropotamo River after heavy rain, often more than one metre, we can easily understand why ancient people would have opted for pile buildings, elevated above the terrain to protect them from periodic flooding.

Archaeological studies in the bay of the Ropotamo River have also contributed to the clarification of the dynamics of changes in the level of the Black Sea over the past 7,000 years. The Neolithic materials from Ropotamo testify that the sea level at the end of the sixth millennium BC is lower than the modern one by significantly more than 5.6 m. Where the coastline was located at this time is not yet possible to say. It can be assumed the Neolithic settlement from which these finds are sourced, as happened in later periods, was located to take advantage of the rich ecological niche which has the resources of the transitional landscape river-sea-land, i.e. the late Neolithic coastline was probably no more than a few hundred metres from the present one.

The above interpretation of site stratigraphy and the taphonomy of Layer 3 allows some chronological conclusions, concerning sea level changes in EBA and later. When the settlement was built at the beginning of the Early Bronze Age, about 3100 BC, the sea level was about 5.6 m lower than the modern one. During the habitation, probably for a short period of time, it rose by about 0.5 m, and during the final flooding of the settlement, which probably occurred 3000–2900 BC, the level rose to about 4.5 m lower than today. Sea level rise continued after the final inundation of the settlement, when a shallow, calm and warm bay formed over the remains. This bay becomes an excellent habitat for the oyster colony of Layer 2: oxygenated water with a high light level and with remnant timber structures providing an ideal anchorage for oyster spat. It is only when the timber has finally eroded to seabed level that the deposition of oyster shell ceases. With the extinction of the oyster colony, the seabed of the bay is progressively covered by coarse marine sand, which in the first millennium BC became the bottom of the ancient harbour.

A sea level change of around 1 metre per one to two centuries over the EBA should be regarded as significant and unusual. Whether this phenomenon is local or not will be confirmed by research on other sites along the Bulgarian coast. In this regard, the simple generalisation of the sea level curve from data of the settlement at Ropotamo and their extrapolation to a larger area may be misleading. The unusual amplitude may be a result of the specific location of the site too, which is sensitive to the river-sea interaction and local tectonic causes.

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