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ORIGINAL PAPER

Disheveled Tenacity: The North Bay of Roman and Byzantine Dor

Ehud Arkin Shalev[1] · **Gil Gambash**[2] · **Assaf Yasur-Landau**[1]

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Abstract
Tel Dor overlooks the eastern Mediterranean on the southern Levantine coastline of Israel. Underwater surveys and a coastal excavation in the North Bay of Dor have produced evidence of an anchorage at the 4th–7th century CE Byzantine city of Dora. The existence of such an anchorage at the northwestern extremity of the city had been contemplated in the past. Also identified are traces of maritime activity from the time period between the 1st century BCE and 3rd century CE and from earlier periods. The concurrent use of the North Bay and the nearby South Bay and Tantura Lagoon during late antiquity mostly took advantage of the natural coastal morphology, augmented only modestly by man-made infrastructure. These three sites served local and interregional maritime traffic at Dor, a clear attestation to a decentralized resource management that resists strict categorization. The resulting image of the maritime interface(s) at Dor does not fit perceptions of a harbor as a spatially rigid, centralized managed phenomenon. Such a seemingly disheveled use of the scarce resource of natural anchorages has shown remarkable tenacity over the *longue durée* in the southern Levant, as typified by Dor in late antiquity.

Keywords Tel Dor · Dora · Roman and Byzantine Anchorage · Underwater survey

Introduction: A Maritime Gateway with No Permanent Harbor?

The site of Tel Dor is located 21 km south of modern-day Haifa and 9 km north of Caesarea, on the coast of Mount Carmel, Israel (Fig. 1). Inhabited nearly continuously from the Middle Bronze Age until the end of the Byzantine period, Dor has produced an extensive assemblage of finds and data attesting to the maritime involvement and maritime connectivity of the area (e.g., Raban 1995; Kingsley and Raveh 1996; Kingsley 2002; Barkan et al. 2013; Kahanov and Mor 2013; Gilboa 2015; Gilboa et al. 2015). The material

✉ Ehud Arkin Shalev
ehud.arkin@gmail.com

[1] Laboratory for Coastal Archaeology and Underwater Survey, The Department of Maritime Civilizations and the Leon Recanati Institute for Maritime Studies, University of Haifa, Mount Carmel, Haifa, Israel

[2] Haifa Center for Mediterranean History, Department of Maritime Civilizations and the Leon Recanati Institute for Maritime Studies, University of Haifa, Mount Carmel, Haifa, Israel

Fig. 1 Location map of Dor

originates from land and underwater excavations and includes local and imported pottery, shipwreck hulls, sounding weights, anchors, weapons, and many other classes of artifacts.

The rich evidence of maritime contacts is mirrored in the prosperity of the city during the Hellenistic and Roman times, when the it reached its greatest extent and displayed its affluence through many urban features as well as a lower town on the slope of the tell and plains at its foot. During these periods, Dor was a flourishing coastal city with rich domestic and civic architecture culminating in the construction of immense Roman temple platforms on the tell (Stern 1994: 272–296; 1995: 38–48, 276–282; Stern et al. 1997; Nitschke et al. 2011: 142–152).

During the 4th–7th century CE, the city, which had by then occupied the lower area east of the tell, continued to thrive through a period of increased rainfall (Dauphin and Gibson 1994; see Hirschfeld 2004 for the climatic conditions) and booming agriculture (Gibson et al. 1999). This period is well attested by the numerous Byzantine shipwrecks in the city's vicinity, which probably plied local and eastern Mediterranean trade routes[1]; and by a very large Byzantine basilica church, which was an episcopal See (Dauphin 1997). Multiple textual sources underscore this vibrant period in Dor's history (see Table 6 below).

Previous surveys have brought up the hypothesis that Dor had some form of marine architecture during classical antiquity in the northern-most bay associated with the city (Kingsley and Raveh 1996; Raban 1995: 289–296). Indeed, this would seem likely for such a coastal city, whose coins still proudly featured a boat accompanied by the inscription

[1] These are, in chronological order, Dor D (Kingsley 2002), Dor 2001/1 (Mor and Kahanov 2006), Tantura A (Pomey et al. 2012), Dor 2006 (Barkan et al. 2013) and Tantura E (Israeli and Kahanov 2014).

"Ruler of the Seas" in the 2nd century CE (Meshorer 1995: 360). And yet, no significant port structures have been found at Dor post-dating the Iron Age (Raban 1995: 310–341; Arkin Shalev et al. 2017). Was Dor then the case of a site that used only informal anchorages, named *Scala* (Horden and Purcell 2000: 142–143) or 'opportunistic ports' (Leidwanger 2013a), or does its maritime interface justify a new category of coastal adaptation?

Focusing on the North Bay, a project of combined coastal excavations and underwater survey was carried out between 2013 and 2015.[2] The coastal excavations focused on establishing the nature and dates of the features initially identified by Kingsley and Raveh (1996) as well as by Raban (1995). An intensive GPS-aided underwater survey was carried out over three seasons in the summer and winter months, aiming to establish the chronology and nature of the maritime activity in the bay. The goal was to better understand how and to what degree the inhabitants of Roman and Byzantine Dor adapted the natural coastline for their use, how this related to other aspects of their urbanized life at the site, and how this may impact current definitions of coastal Levantine harbors.

The North Bay

The sandy coastline stretch with its occasional bay along the coast of the Carmel has often been described as 'inhospitable' (e.g., Kingsley 2001: 70–71; Laiou and Morrison 2007: 15), yet it has an extensive record of maritime activity dating back to the Early Bronze Age. Frequent use was made of the natural morphology enhanced by modest infrastructure (Yasur-Landau et al. 2018). Indeed, Tel Dor itself is situated amid a lagoon and three bays offering varying degrees of shelter from different directions. From south to north, these are the Tantura Lagoon, the South Bay, the Love Bay, and the North Bay (Fig. 2). The North Bay is an elongated body of water measuring 460 m in length and 175 m in breadth at its widest point, aligned in a NNE–SSW orientation. There is a single entrance channel (Fig. 2, Area A) in its northern extremity, which avoids the accumulation of sand by localized currents. Directly north of the entrance channel is a small circular inlet that is open only to the southwest and is deeper than the rest of the bay, with a maximum of 7 m depth (Fig. 2, Area B). The main body of the bay (Fig. 2, Area C) is currently sand-filled with a maximum of only 3 m depth, like all four bays of Dor. Remains of walls and other structures are visible only on the coast of the southern part of the bay (Fig. 2, Area D) while the coast of the northern part of the bay was likely outside the urban area of both Roman and Byzantine Dor. An exposed and heavily quarried limestone ridge runs on the windward side of the bay parallel to the shore (Fig. 2) and affords limited protection from the region's

[2] The field work for this research was carried out as part of the Tel Dor Excavation Project. The survey and the excavations were conducted by student divers from the Department of Maritime Civilizations at the University of Haifa as well as volunteer divers, for whose support we are grateful. Underwater operations were carried with the help of the Maritime Workshop of the Leon Recanati Institute for Maritime Studies at the University of Haifa.Alexandra Ratzlaff and Inbal Samet served as area supervisors for the coastal excavation. All work was carried out by kind permission of the Israeli Antiquities Authority (permits S389/2012, G-2/2014 and S534/2015) and the Israel Nature and Parks Authority. We thank Kibbutz Nahsholim for their kind support and cooperation. Support for this project was provided through funding and grants from the Honor Frost Foundation, the Israel Science Foundation, the Lady Irene and Sir Maurice Hatter Scholarship Fund, the PADI Foundation, the Rotary Club Moriah-Haifa Branch and the Dept. of Maritime Civilizations at the University of Haifa.

Fig. 2 The bays in the vicinity of Tel Dor: (1) the Tantura Lagoon; (2) the South Bay; (3) the Love Bay; (4) the North Bay with survey areas. Kibutz Nachsholim is seen in the southeastern corner with modern fish pools directly to its north

generally southwesterly winds. This has the effect of turning the North Bay into a natural yet less than ideal anchorage.

A Re-evaluation of Possible Maritime Structures

The North Bay of Dor contains the exposed remains of several public structures, none of which was systematically excavated. These include a Roman theatre, 60 m in diameter, located some 50 m east of the current coastline (Leibovitz 1950) and a rectangular structure measuring 37 × 35 m at the south end of the bay, near the present-day waterline. The foundation course of its sea-facing façade is made of massive ashlars laid as headers. Raban documented the structure (1995: 290, fig. 9.9) and excavated a trench mechanically along one of its walls. An examination of the limited and unpublished pottery from this trench may indeed support a Roman date.[3] Raban interpreted the building as a 2nd–4th century CE storage facility (Raban and Galili 1985: 339), a hypothesis supported by the monumental appearance of the structure, as well as by its location immediately next to the seashore and it being the closest structure to the anchorage. Storerooms came in a variety of forms in the Roman world. They included not only the more common types of storage rooms, arranged around a courtyard or on both sides of a corridor, but also multi-room formations, or house-like structures, such as the second century *Horrea Epagathiana et Epaphroditiana* in Ostia (Rickman 2002). While the identification of the Great Rectangular structure in Dor as a warehouse connected with the activity of the anchroage requires a more extensive excavation of the structure, it remains a plausible option to be the only structure connected with the harbor infrastructure of Roman Dor.

Several other features located in the North Bay were interpreted in the past as relating to maritime activity. Two of these were excavated in the recent campaign: a wall interpreted as a quay by Raban (1995: 294, figs. 9.16, 9.18), located south of the rectangular structure and now designated as Wall 101; and two stone bollards north of the rectangular structure, which were believed by Kingsley and Raveh to rest on a Roman quay (1994: 292).

Quay South of the Rectangular Structure?

A series of walls and channels had been interpreted by Raban as a small harbor basin with a stone-built quay and adjoining flushing channels (Raban and Galili 1985: 339–341; Raban 1995: 289–296). Following this, Raban mechanically excavated two trenches, 'CC' and 'DD', perpendicularly to the alleged quay, in order to establish its date and construction method (Raban 1995: 293, fig. 9.3). He then concluded that these features "seem to have been part of a complex which bordered a shallow water basin 30 × 50 m. in size. This basin was probably large and deep enough for small freighters. The quay itself comprises two courses of headers laid into a compact dark mud, the top of which is at 0.20 m. below MSL. Sherds of the 1st and 2nd centuries CE found in the upper part may date the quay" (Raban 1995: 294–295).

[3] Reviewed and published with kind permission of the Leon Recanati Institute for Maritime Studies. DY-13-4-83חמז-3\5 is a Keay Type XVI Variant A Amphora (Keay 1984: 149, 155) dated to the 3rd c. CE, and DY-13-4-83חמז-3\1 is an unclassified Palestinian bag jar in gritty Orange Fabric from Caesarea (Johnson 2008: 89, nos. 1081, 1082), dated to the Late Roman to Byzantine period.

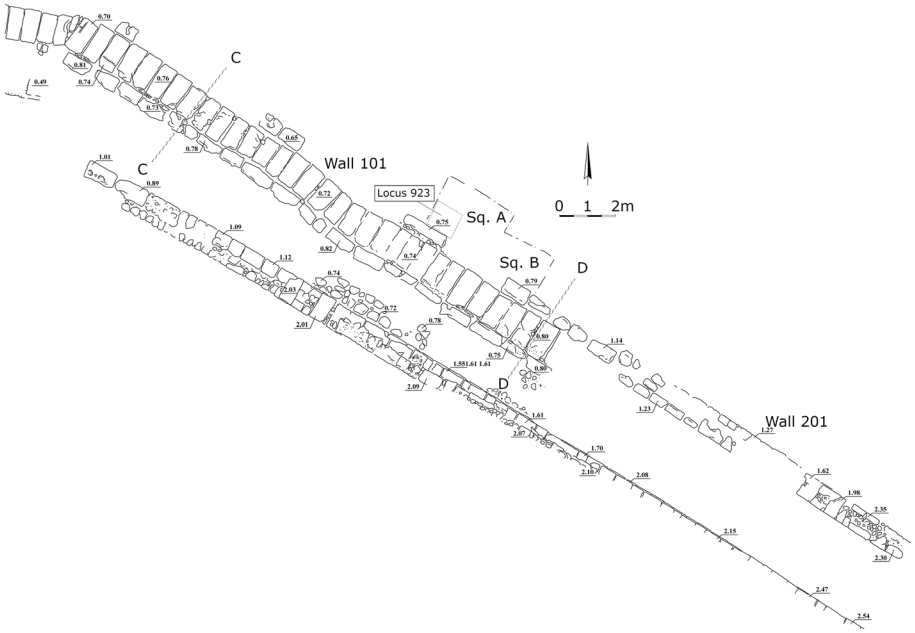

Fig. 3 Plan of the excavations by Wall 101 in Area D with Raban section s CC and DD (plan by S. Pirsky)

Fig. 4 Wall 101 in Area D, facing north-west (photo by E. Arkin Shalev)

In order to examine these conclusions we chose to excavate manually a stratigraphic section north of this wall, which we designated as Wall 101 in Area D (Figs. 3, 4). Two adjacent excavation squares (A and B), covering an area of 9 sqm in all, were opened on the northern side of Wall 101. In order to avoid previously disturbed and excavated

Fig. 5 Final photo of the excavation of Wall 101 in Area D, facing south-west (photo by E. Arkin Shalev)

deposits, these were located in an area between the two trenches previously cut by Raban (1995: 293, fig. 9.3, Trenches 'CC' and 'DD').

The wall lies on a NW–SE axis. The height differential measured between its two ends is only 10 cm over a 30 m span (rising toward the southeast), creating a 0.33% height gradient. As the excavation quickly reached levels below sea levels, it was necessary to use a pump to drain the excavation squares, and to place sandbags to support the wet sediment. In both of the squares excavated by our campaign, Wall 101 was found to comprise only one course of hewn headers, bound on both sides by stretchers standing on their narrow side. The headers are 140 cm long, 40 cm wide, and 71 cm tall on average. Stretchers were measured to be near 110 cm long, 50 cm wide, and 70 cm tall. No cementing or plastering is visible on the stones.

Small fieldstones can be seen filling a gap between the row of headers and the northern row of stretchers. The wall rests on a deposit of seashells approximately 7 cm thick, extending in all directions (Fig. 5). The shells are neither worn nor broken, suggesting that they may have been placed there intentionally, rather than being deposited via wave action. The use of seashells as construction material was also documented in the construction of Wall 201, located east of Wall 101 (Fig. 6).

Fig. 6 Southwestern face of Wall 201 in Area D, facing north-east (photo by E. Arkin Shalev)

Below the seashells, a matrix of grapefruit-sized fieldstones was uncovered. It extends at least 1 m north-east of the wall (Fig. 5) and includes pottery sherds and intrusive modern remains. Several sherds of Palestinian bag jars from this matrix can only be dated generally as Roman/Byzantine, but two gutter-rimmed bowls from Locus 923, the deepest part of the fieldstone matrix and of the overall excavation, may be dated more specifically to the late 1st–3rd centuries CE. This date range matches both Raban's original suggestion for dating this feature as well as the time of Roman urbanization on the tell.

Looking at a possible maritime function for Wall 101, it may be noted that the top level of its single remaining course is near 0.85 m above msl, while the bottom level is at 0.18 m above msl on average. This effectively precludes it from having been used as a quay during the Roman era, when the sea level was similar to, or lower than, the current one (Sivan et al. 2004; Anzidei et al. 2011: 18). Even Late Roman and Byzantine sea levels, estimated to have been up to 40 cm above today's (ibid.), allow for only 22 cm of water above the base of the wall. Yet even this allows for only half the draught afforded by shallow water quays, such as that found in the harbor of Phalasarna (Hadjidaki 1996: 61–62, fig. 6).

Rather than a quay, Wall 101 may have been a massive wall with an external face of headers bound by stretchers and an internal rubble core, datable to the Roman period by the ceramic remains located within its foundations. It is similar in dating, dimensions, and construction techniques to the walls of the inner courtyard of the public building found at the southeastern end of Area B2 (Stern 1994: 280, fig. 191). A similar wall was excavated by Moshe Negev in the Herodian nymphaeum in Caesarea on the northwestern projection of the Temple Platform (Levine 1975: 19, pl. 3.2; Patrich 2011: 110).

Bollards and Quay North of the Rectangular Structure?

Two stone bollards located in the North Bay were previously reported by Kingsley and Raveh (1994: 292). These were recovered by the present campaign and designated DN43 and DN44 (Fig. 7). They are situated in the southern end of the bay at the current waterline, 26 m apart one from another. Kingsley and Raveh (1994: 292–294) hypothesized

Fig. 7 Stone bollards DN43 (left) and DN44 (right), facing north-west (photo by E. Arkin Shalev)

Fig. 8 Final photo of the excavation of Bollard DN44, facing south

the existence of a stone quay oriented on a north–south axis on which these bollards stood, with another, 65 m long stone-built jetty, perpendicular to the quay. Their suggestion was based on the bollards as well as on numerous hewn stones and column drums they found underwater in the immediate vicinity (see below: The Underwater Survey).

A trial excavation trench centering on Bollard DN44 was conducted as part of the current campaign in order to ascertain whether a quay or any other structure could be identified beneath it or in its vicinity. The trench eventually covered an area of 30 sqm in all directions surrounding the bollard. Layers of loose, dry sand were exposed with compact wet sand below them; further down a clay layer was found 80 cm below the opening elevations. Directly below this layer the water table was reached and the excavation trench was flooded, requiring periodic pumping of water. Throughout the excavation hewn sandstones of varying sizes were found at random elevations, forming no discernable pattern or structure in any direction of the bollard. The excavation stopped 93 cm below the topsoil level and 21 cm lower than the bottom elevation of Bollard DN44 (Fig. 8).

The lack of any foundations, structure, or consistent dispersal patterns of hewn stones disproves Kingsley and Raveh's original hypothesis regarding a quay or jetty serving as the base for the stone bollards. Furthermore, the lack of a clear relationship between the bollards and any other archaeological feature or data does not allow to date their construction or use. Instead, these technically and morphologically primitive bollards may have been free-standing masses of rock, using their considerable weight to provide a mooring point for vessels in the bay.

The Underwater Survey

The existence of archaeological finds in the water was reported by past underwater surveys in the North Bay, which noted mainly column drums but also a large number of architectural elements (Kingsley and Raveh 1994: 291–293). This notwithstanding, only three pottery sherds from the North Bay have been previously published, in contrast to the multitude of finds originating from the other three bays of Tel Dor (Kingsley and Raveh 1996).

This underwater survey was aimed at mapping activity areas within the bay and producing a diachronic picture of maritime activity conducted in it. To these ends, a systematic, comprehensive, GPS-aided diver survey of the bay was conducted over three seasons, and the location of every pottery concentration, worked stone, ballast heap, and other finds was recorded. Divers swam east to west transects along a line laid out on the sea floor, beginning in the southern end of the bay. At times of poor visibility, typically less than 1 m, the number of divers was kept at a minimum of two and the distance between them reduced. This was done to minimize the task load on the divers and allow for better control of the dive team. During periods of improved visibility, as high as 10 m, the number of divers was increased up a maximum of five. A surface snorkeler accompanied the divers, recording the locations of all survey finds using a handheld GPS device, which enabled to place data spatially and to identify distribution patterns (Fig. 9). Upon the completion of a transect, the line was advanced to the north. During this survey, the entire area of the bay was covered twice, both in winter time and in the summer, to take advantage of shifting sand coverage. A total of 160 dives were performed, for a total of 160 h under water.

The Ceramic Evidence from the Underwater Survey

The main body of ceramic finds in the bay, originating from Areas A and C, is composed mostly of storage and shipping containers of the Roman and Byzantine periods, and may indicate the height of maritime activity in the bay (Table 1; Figs. 10, 11). A total of 933 pottery sherds were collected under water, most of which were found uncovered, loose, and subjected to much physical wear by wave energy and sediments.

Three hundred and twenty-five sherds were preserved enough to enable their broad functional categorization as plain or fine wares, storage jars, and large storage containers. These sherds also allowed for outlining a general chronological range. Forty-nine percent of them dated to the Byzantine period at Dor (4th–7th centuries CE) and 23% to the Roman period (1st BCE–3rd centuries CE); 14% could only be classified as 'Roman or Byzantine' and 8% were Hellenistic. Seventy-four percent of this assemblage were identified as sherds belonging to large storage containers.

Seventy diagnostic sherds, constituting the remains of 25 individual vessels, enabled to identify clearly types and chronological ranges. Twenty of these vessels are discussed below,

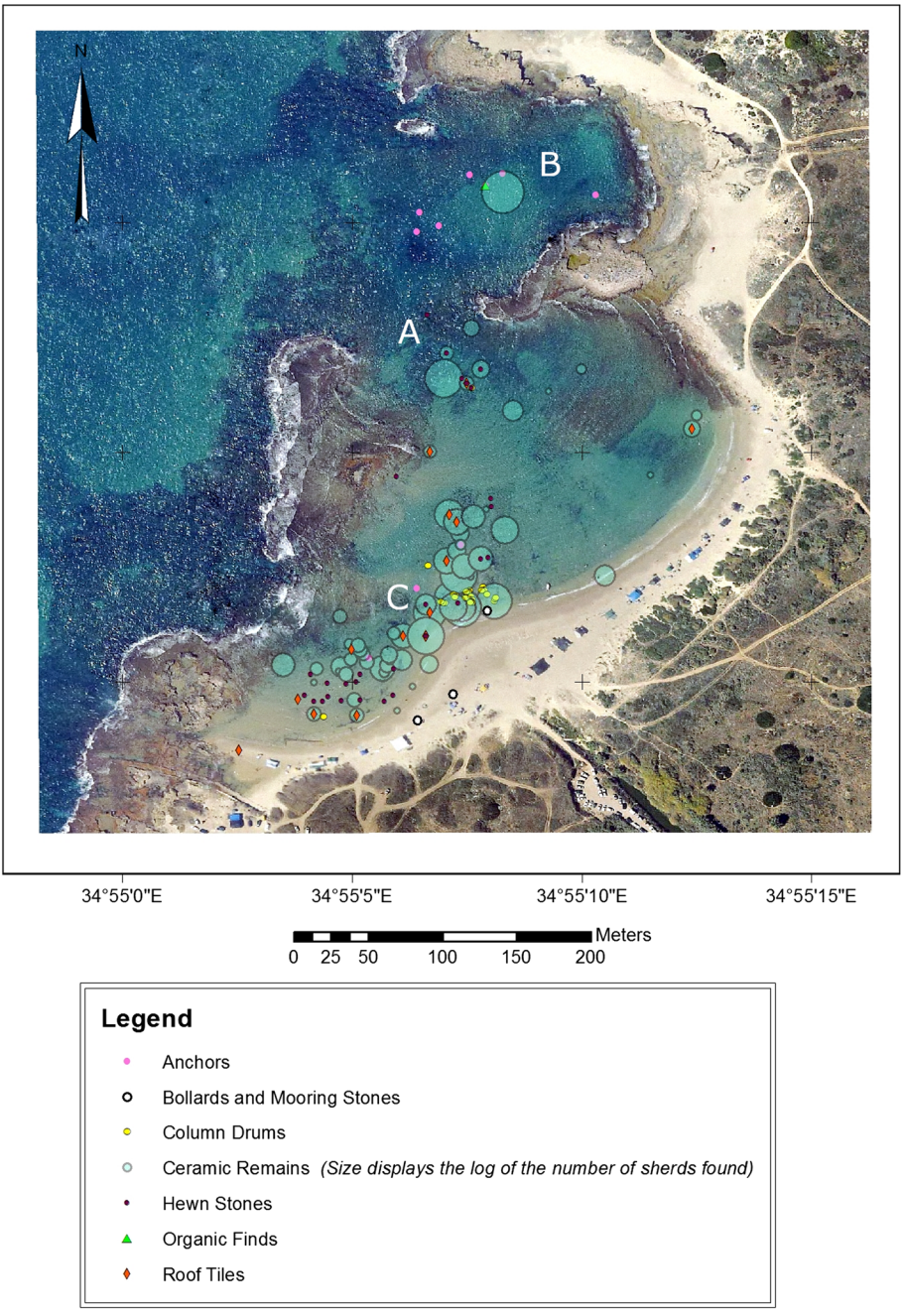

Fig. 9 The underwater survey area and finds from the survey (data by E. Arkin Shalev)

Table 1 Byzantine ceramic assemblage from the North Bay of Dor

Fig.	Fabric plate	Reg. no.	Type	Main date range	Description
10.1	1.a	S389-2012-DN-406-6	LRA5 storage Jar	4th–6th c. CE	Triangular rim; short cylindrical neck; ribbed body
10.2	1.b	S389-2012-DN-407-2	Riley's Caesarea Type 1C storage jar	4th–7th c. CE	Beaded rim; short, slightly outward bulging neck; grooved ring handle wider at its connection points to the body than along the handle; globular, bag-shaped body with fine ribs from the neck to 1 cm below the bottom handle attachment point and coarser ribs beginning 4 cm below the bottom handle attachment and continuing downward; additional layer of clay on all surviving body parts, which may indicate double throwing on the wheel
10.3	1.c	S389-2012-DN-X-11-22	LRA4b amphora	5th–7th c. CE	Very low triangular rim; no neck; grooved-upward trending ring handles; smooth shoulder
10.4	1.d	S389-2012-DN-303-1	LRA1 amphora	4th–7th c. CE	Beaded rim; ribbed conical neck; handles have double-ridged external and elliptical internal face
10.5	1.e	S389-2012-DN-412-1	YA1 Subtype II amphora	5th–7th c. CE	Collared rim; short cylindrical neck; downward-curving bifid handle
10.6	1.f	S389-2012-DN-343-1	LRA4c amphora	4th–7th c. CE	Simple vertical rim, no neck, gently rounded shoulders
10.7	1.g	S389-2012-DN-42-2	LRA4c amphora	4th–7th c. CE	Simple vertical rim; no neck; gently rounded shoulders; excess clay on shoulder area
10.8	1.h	S389-2012-DN-410-1	Riley's Caesarea Type 1x storage jar	4th–6th c. CE	Crudely shaped grooved ring handle with irregular pinched spots; handle is skewed and rests at about 80 degrees from the body; thin body with flat ribbing that starts 2 cm below the bottom handle attachment points
10.9	1.i	S389-2012-DN-X-8	Riley's Caesarea Type 1C storage jar	4th–7th c. CE	Grooved ring handle that tapers toward the top; thin, globular body with fine grooves
10.10	1.j	S389-2012-DN-X-6	YA1 Subtype Ia amphora	5th–7th c. CE	Short vertical handle with three ridges
10.11	–	S389-2012-DN-505-2	Late Roman C bowl (Phocaean Red Slip Ware)	5th–7th c. CE	Shallow bowl with a ring base; dark red slip

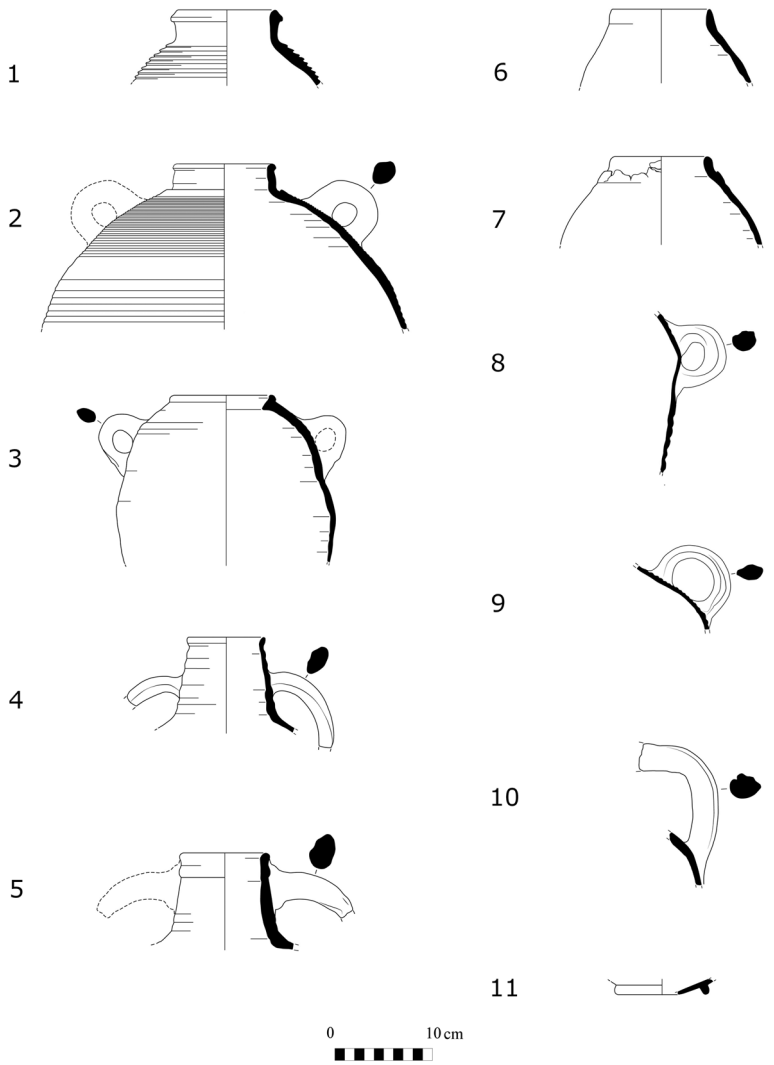

Fig. 10 Byzantine ceramic assemblage (drawing by S. Haad)

with the remaining five offering no additional qualitative information. These 70 sherds showed similar trends as the previous group of 325 sherds, with 52% dated to the Byzantine period and 28% to the Roman period. Seventy-six percent of the vessels in this group were identified as large container types: storage jars, amphorae, and dolia. Local forms tend to dominate the Byzantine period vessels, while imported vessels form the majority of Roman finds. Other periods encountered in the survey include Bronze Age, Iron Age II, Hellenistic, Early Islamic, and Ottoman, each represented by only one or two sherds. A final group of 538 non-diagnostic sherds, worn and eroded, were discarded due to their poor condition.

Local types comprise the majority of the diagnostic finds of the Byzantine period, with strong parallels in nearby Caesarea, in the agricultural hinterland of Dor, and in shipwreck cargoes in the area (Table 1). Several Gaza Jars of the LRA4B and 4C categories, dated to

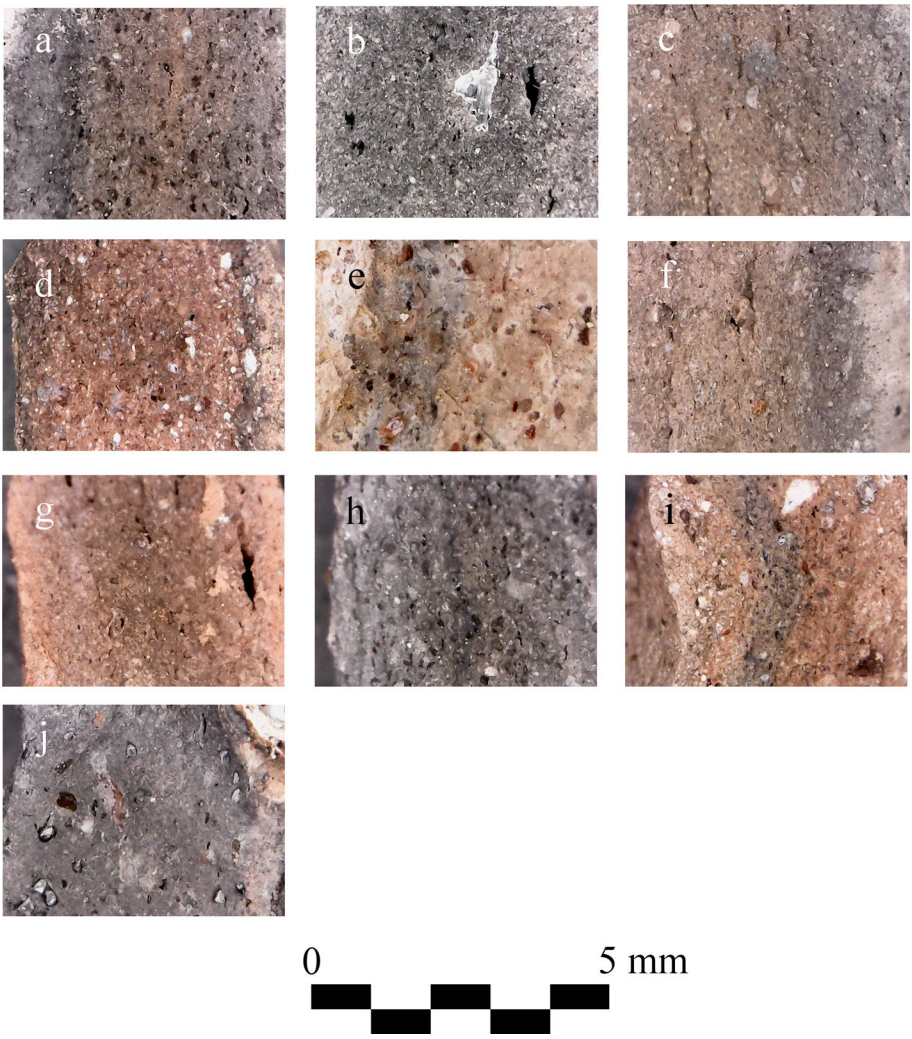

Fig. 11 Fabric close-up images of the Byzantine ceramic assemblage

the 4th–7th centuries CE, were identified (Fig. 10.3, 10.6, 10.7; Pl. 1.c, 1.f, 1.g). These are similar to the amphorae found in the nearby 6th century Dor D and Dor 2001/1 shipwrecks (Kahanov and Mor 2013: 20, fig. 34 no. 12) and in Caesarea (Johnson 2008: 97–98, no. 1184). Several variants of Palestinian bag jars were also collected during the survey. These include Riley's Caesarea Type 1C (Fig. 10.2, 10.9; Pl. 1.b, 1.i; Riley 1975: 27, no. 3), found also in Caesarea and at Horbat Kastra some 15 km north-east of Tel Dor (Johnson 2008: 85, 88, 179 fig. 1037; Haddad 2009: 81, fig. 2:4), Riley's Caesarea Type 1x with parallels in the 4th–6th centuries CE trenches of the Caesarea Hippodrome (Fig. 10.8; Pl. 1.h;Riley 1975: 27, no. 7) and a LRA5 type (Fig. 10.1; Pl 1.a) similar to vessels found in the cargo of the 6th century Dor D shipwreck (Kingsley 2003: 88, Fig. 3). This globular, straight-necked, bag-shaped amphora had production centers in the Caesarea and Negev areas (Riley 1979: 223; Peacock and Williams 1986: 191–192; Magness 2003: 184; Reynolds

2005: 573–574, 606, figs. 145–148) and enjoyed a wide distribution in the whole of the eastern Mediterranean and the North African basins, peaking in the 4th–6th centuries CE.

This assemblage is typical of the southern Levantine coast and inland, the hinterland of Dor, and nearby shipwreck assemblages. Further afield these LR4 and LR5 variants enjoyed a wide distribution around the Mediterranean, due mainly to the massive export of Gaza and Ascalon wines (Mayerson 1985, 1993; Pieri 2012).

Non-local forms include three LRA1/Yassıada subtypes (Fig. 10.4, 10.5, 10.10; Pl. 1.d, 1.e, 1.j). Parallels have been found in the 7th century Byzantine shipwreck at Yassıada (van Alfen 1996: 192–194) and in the 6th–7th centuries CE Cape Zevgari shipwreck in Cyprus (Leidwanger 2007: 308–311). This type was found in abundance in the 5th–7th centuries CE Aegean, northern Levant, Egypt, and Palestine (Peacock and Williams 1986: 185–187; Reynolds 2013: 102–103). Its reccurring role in the overseas trade at Dor is evidenced in the ceramic assemblage from the North Bay as well as in those of the early 6th century CE Dor 2001/1 (Kahanov and Mor 2013: 20–21) and the 6th–7th centuries CE Dor 2006 Byzantine shipwrecks (Barkan et al. 2013: 125–127). Several production centers have been identified in Turkey and Cyprus and on Kos (Waksman et al. 2014: 921–922).

Temporal outliers in the ceramic assemblage from the North Bay reflect Dor's long occupation (Table 2; Figs. 11, 12). These include Middle Bronze Age cooking pot (Fig. 11.1; Pl. 2.a; Kempinski 2002: 166–167, fig. 5.56:4), and a Bikai Type 9 Tyre Storage Jar from Area B (Fig. 11.2; Pl. 2.b; Bikai 1978: 45–46, pl. XIV.16), pointing to the possible use of this area in the Iron IIC and Iron III/Persian period. A late Hellenistic or early Roman period Eastern Sigillata A plain bowl, common in Caesarea (Fig. 11.8; Johnson 2008: 35, no. 213), is the only plain ware vessel in the assemblage. Roman period storage and transport vessels include a Peacock and Williams' Class 9/'Rhodian Type' amphora (Figs. 11.6, 11.7; Pl. 2.d, 2.c; Peacock and Williams 1986: 102, Fig. 37) with parallels in Caesarea (Blakely 1988: 41, Fig. 9.1) and the late 1st century CE Antikythera shipwreck (Grace 1965: 5–6), a tentatively identified Dressel 14 amphora (Fig. 11.4; Pl. 2.e; Peacock and Williams 1986: 126, fig. 56), a Ras al Bassit dolia (Fig. 11.5; Pl. 2.f) with parallels from a 2nd century CE Roman shipwreck in the Fig Tree Bay off south east Cyprus (Leidwanger 2013b: 198–199), the South Bay of Dor (Kingsley and Raveh 1996: 48, fig. 34:P12) and possibly the underwater survey off Kfar Samir some 22 km north of Dor (Haddad 2009: 86–87, figs. 6.9), a Mid-Roman Amphora 4 vessel (Fig. 11.3; Pl. 2.g; Robinson 1959: 82, 106, pl. 28.M 239) with parallels in Caesarea (Johnson 2008: 102, 190 fig. 1233) Benghazi (Riley 1979:186–187) and Ilion (Heath and Tekkök 2006–2009: K17.0780:1). The latest piece in the assemblage is a late 12th or 13th century CE Glazed Ware bowl (Fig. 11.9; Pl. 2.h; Stern 2012: 119, pl.4.55 no. 5) and may attest to the use of the North Bay during the 12th and 13th centuries CE, when a fort known as 'Merle' was located on the western promontory at the top of Tel Dor (Ellenblum 2007: 97, 306).

Anchors and Net Weights

A total of seven stone anchors, two small stone net weights, and a single iron anchor were documented in during the underwater survey. Of these, six stone anchors and a single iron anchor were found in close concentration in Area B (Table 3, Figs. 9, 13). Stone anchors are present in many ancient anchorages and boats, being used and re-used until modern times. In light of this, where there is no clear association of an anchor with other finds, a typological parallel was included as a baseline for future discussion, recognizing that these

Table 2 Ceramic outliers from the North Bay of Dor

Fig.	Fabric plate	Reg. no.	Type	Main date range	Description
11.1	2.a	S389-2012-DN-Small-Bay-5	Cooking pot	Middle Bronze Age	Thick beaded rim; no neck; rounded shoulder
11.2	2.b	S389-2012-DN-Small-Bay-2	Bikai Type 9 Tyre storage jar	7th–6th c. BCE	Round and slightly beaded rim; no neck; sharply carinated shoulder; ridged, downward-sloping ring handles; the bottom connection point of the handle to the body has a lump of extra clay reinforcing the area; the fabric has a slightly metallic ring
11.3	2.g	S389-2012-DN-52-1	Mid-Roman Amphora 4	2nd–4th c. CE	Thick beaded rim; short cylindrical neck; sharp carinated shoulder; short vertical handle joins the neck below the rim and ends at mid-shoulder, with two pinched ridges
11.4	2.e	S389-2012-DN-347-2	Possibly a Dressel 14 amphora	1st–3rd c. CE	Long, hollow, tapered base
11.5	2.f	S389-2012-DN-403-2	Ras al-Bassit jar/transport dolium	2nd c. CE	Knobbed toe of base
11.6	2.d	S389-2012-DN-X-1	Peacock and Williams' Class 9/'Rhodian Type' amphora	2nd c. BCE–2nd c. CE	Knobbed toe of base; Black crystallized remains found inside the base
11.7	2.c	S389-2012-DN-347-12	Peacock and Williams' Class 9/'Rhodian Type' amphora	2nd c. BCE–2nd c. CE	Peaked handle with round section
11.8	–	S389-2012-DN-505-3	Eastern Sigillata A plain bowl	Late Hellenistic–Early Roman	Base, body and part of a flared rim of a plain bowl
11.9	2.h	S389-2012-DN-402-9	Turkey and Greece Glazed Ware type bowl; TUR/GR.GL.3	Late 12th–13th c. CE	Ring base and part of the body internally and externally green glazed; possible traces of white slip beneath the glaze layer; one or more spirals of sgraffito decorations; tripod marks visible on the interior and exterior of the base

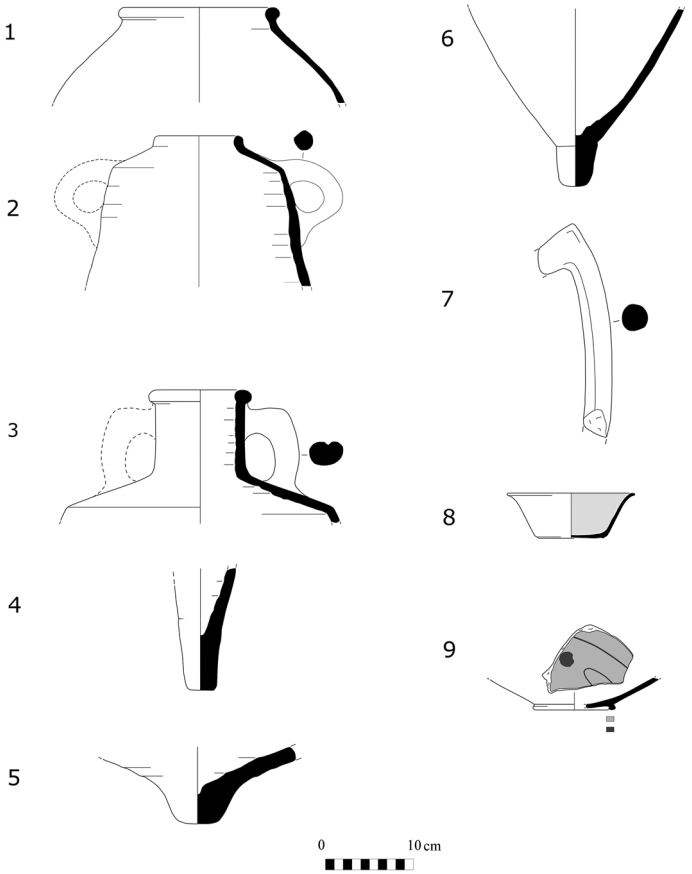

Fig. 12 Ceramic assemblage: temporal outliers (drawing by S. Haad)

anchors may well have been re-used during the Byzantine period, when maritime activity in the North Bay probably reached its peak (Table 3).

Two stone anchors found in Area B, anchor DN-NWSB-anc-3 and anchor DN-NWSB-anc-5, were located in close proximity to the remains of ceramic vessel S389-2012-DN-Small-Bay-2. This vessel, a Bikai Type 9 Tyre storage jar, is dated to the 7th–6th century BCE (see above: The Ceramic Evidence from the Underwater Survey). Anchor DN-NWSB-anc-3 (Fig. 12.3) is a rectangular anchor with one large hole dominating its upper half. A similar anchor was documented off the bow of the mid-8th century BCE *Tanit* shipwreck in deep water off Ashkelon (Ballard et al. 2002: 164, fig. 3). Anchor DN-NWSB-anc-5 (Fig. 12.5) is a single-hole anchor of a type usually associated with the bow anchors of the Late Bronze Age Uluburun wreck (Pulak 1998: 217, fig. 25), but a similar anchor was found at the Neve Yam Iron Age I to Iron Age IIA wreck site (Yahalom-Mack et al. 2014: 173, fig. 2c).

A single iron anchor, reg. no. DN-NWSB-anc-6, was identified in Area B (Fig. 14). It has a shank length of 2.91 m, a ring diameter of 35 cm, and an arm length of 40 cm. Based on its size and form and on the possibility that it had a removable stock, it may have been an Early Roman Imperial anchor (Kapitän 1984: 42–43, fig. 8B). A similar anchor was

Table 3 Stone anchors and sinkers from Area B

Fig.	Reg. no.	Dimensions (height, width, thickness) in cm	Description	Typological parallel
12.1	DN-NWSB-anc-1	70, 41, NA	One-hole stone anchor with flat base and wide top, parallel to the bottom; one side runs perpendicular to top and bottom while the other forms a diagonal; the large hole is conical and located in the top half of the anchor	Temple of Obelisks at Byblos (Frost 1963: 4, fig. 3); South Bay of Dor (Anchors AN04 and AN09: Kingsley and Raveh 1996: 35, fig. 28, pl. 31); 'Atlit (McCaslin 1980: 41–44, fig. 25, no. 27)
12.2	DN-NWSB-anc-2	65, 47, NA	Similar to DN-NWSB-anc-1; a one-hole trapezoidal stone anchor with a flat base and parallel top; one side is nearly perpendicular to the top and bottom and the other forms a diagonal from top to bottom; the hole is conical and is located in the top third of the anchor	Temple of Obelisks at Byblos (Frost 1963: 4, fig. 3); South Bay of Dor (Anchors AN04 and AN09: Kingsley and Raveh 1996: 35, fig. 28, pl. 31); 'Atlit (McCaslin 1980: 41–44, fig. 25, no. 27)
12.3	DN-NWSB-anc-3	50, 35, > 12	A one-hole rectangular stone anchor; the large hole dominates one half of the anchor	Mid-8th c. BCE *Tanit* shipwreck in deep water off Ashkelon (Ballard et al. 2002: 164, fig. 3)
12.4	DN-NWSB-anc-4	60, 38, > 30	A well-worked, rectangular, two-hole stone anchor; round top hole; nearly square bottom hole	Unusual anchor: has no immediately available parallels.
12.5	DN-NWSB-anc-5	96, 66, > 14	A well-worked one-hole stone anchor, rectangular with a rounded top	Neve-Yam Iron Age wreck site (Yahalom-Mack et al. 2014: 173, fig. 2c)
12.6	DN-NW-4	34, 28, 6	A small, three-holed stone sinker, trapezoidal with a flat, wide, rounded top; two holes are in the bottom fourth of the anchor and one in its top third	Anchor AN110 found in the Love Bay of Dor (Kingsley and Raveh 1996: 41, fig. 32, pl. 36)

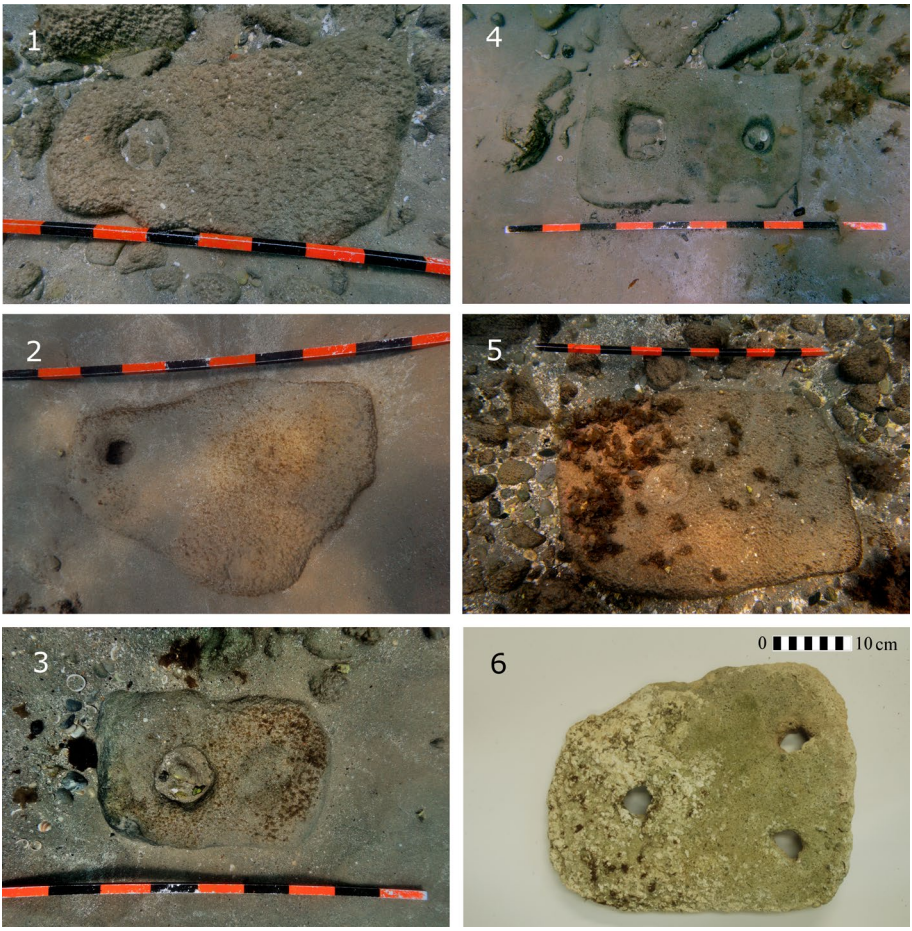

Fig. 13 Stone anchors and sinker from Area B (photos by E. Arkin Shalev)

found in the South Bay of Dor (Kingsley and Raveh 1996: 23, MA10, fig. 21, pl. 18). Area C, the main bay area, yielded only one stone anchor and two smaller artifacts possibly used as net sinkers (Table 4, Fig. 15).

Architectural Remains and Ballast Stones

Large amounts of construction elements were identified underwater in Area C (Fig. 9). These include hewn stones of various sizes (Fig. 16) as well as 25 column drums, most with a central depression, in close proximity to one another (Table 5). A dozen of these were previously reported (Guérin 1984: 214; Kingsley and Raveh 1994: 293; Raban 1995: 289). The 25 column drums were located along an east–west-oriented arc, covering an area measuring 35 × 15 m.

When examining the diameter of the 25 drums and the morphology of their central depression, it becomes apparent that there are six distinct groups of three to four drums

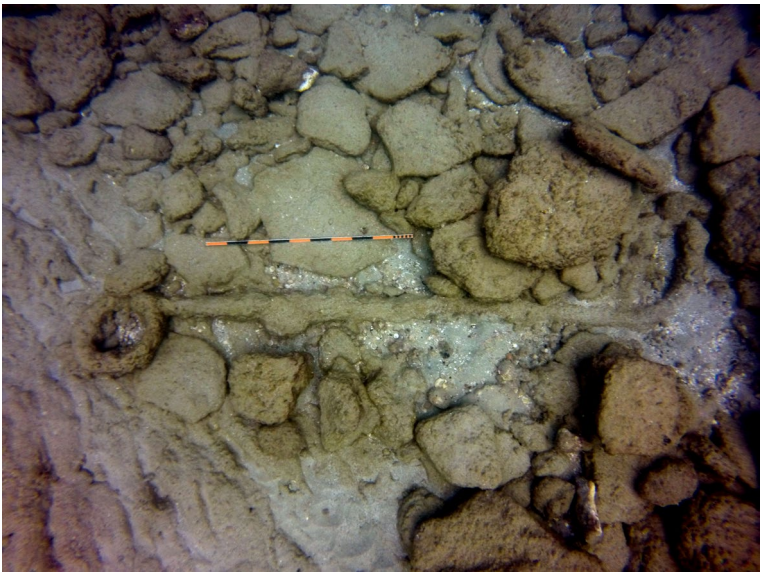

Fig. 14 Iron anchor DN-NWSB-anc-6 from Area B (photo by E. Arkin Shalev)

each, which include 22 of the drums. The drums in each group are similar in dimensions and in the characteristics of their central depression, and differ in these respects from those in other groups; the items of each group were found close to one another. Three of the 25 column drums found could not be associated with any group based on their dimensions (Fig. 17).

Columns constructed using similar drums appear at Dor in structures dated to the Roman period: the colonnaded roof of the monumental façade of the public building in Area B2 (Stern 1994: 281, fig. 192); the colonnade on the western edge of the tell (Conder and Kitchener 1882: 8); and the columns of the Roman seaside temples in Area F of the tell (Nitschke et al. 2011: 149, fig. 25). Additional columns are located throughout the site out of context.

Additional artifacts located in Area C include a reworked marble cornice (Figs. 18.1a, 18.1b, 18.1c), a Roman table foot (Fig. 18.2) and two ceramic roof tiles (Figs. 18.3a, 18.3b, 18.4a, 18.4b). All finds were located amidst piles of ballast stones—partially worked stones up to 30 cm in diameter, some of non-local origin (Holdman 2017).

A large mooring stone, DN207, was found in shallow water. It is estimated to have originally measured 1.3 m long × 1 m wide, thickness cannot be determined (Fig. 19). Nearly identical mooring stones have been found -in situ in the Augustan harbor of Misenum in southwestern Italy, where they had been inserted into the circular head of the harbor's concrete breakwater or located near it on the sea floor (Gianfrotta 1996: 70–72). Similar mooring stones have been identified in the Roman period harbors of Tiberias and Magdala (Bonnie 2017). A depiction of such a mooring stone integrated into port structures at Portus appears in the bottom right-hand corner of the early 3rd century CE Torlonia relief (Blackman 1982: 84, fig. 2).

Finally, a unique stone statue base with a Greek dedicatory inscription of the Roman Governor Gargilius Antiquus dating to the 2nd century CE, reused as a building element, was also discovered (Fig. 20). The use and reuse of this inscribed base, as well as the

Table 4 Stone anchors and sinkers from Area C

Fig.	Reg. no.	Dimensions (height, width, thickness) in cm	Description	Typological parallel
14.1	DN-anc-7	65, 25, NA	A three-hole stone anchor, trapezoidal in shape; the upper hole occupies the middle of the upper half, while the two lower holes are located in the bottom fourth of the anchor	Anchor documented in the water off the coastal Crusader site of Arsur/Arsuf (Grossmann and Kingsley 1996: 49–54) and at the late 13th c. CE Na'ama wreck in the Red Sea (Raban 1990: 302, fig. 3 no. 23)
14.2	DN-502	28, 21, 7	A small, three-hole stone sinker; roughly triangular in shape with a rounded top and flatter bottom; all three holes are equally spaced and linearly placed between the apex of the anchor and the mid-point of its base	An exact parallel has not been found. Examples of net sinkers with three or more holes have been found in the Sea of Galilee (Nun 1993: 47–51)
14.3	DN-74	22, 27, 9	A small one-hole stone sinker; roughly triangular in shape	Net sinker from the Sea of Galilee (Nun 1993: 48, top image, middle row, third from right)

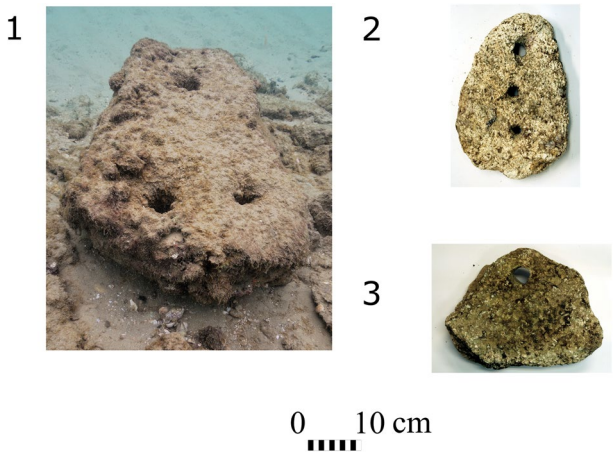

Fig. 15 Stone anchor and sinkers from Area C (photos by E. Arkin Shalev)

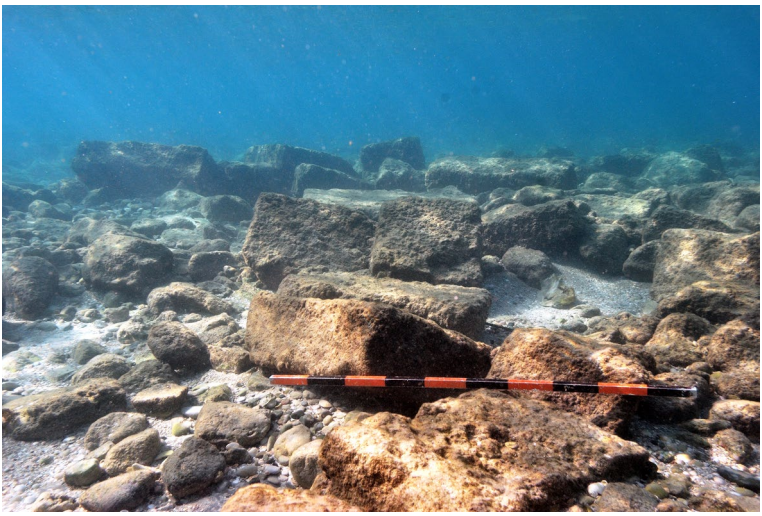

Fig. 16 Hewn stones from Area C (photos by E. Arkin Shalev)

inscription's historiographic significance, are discussed elsewhere (Gambash and Yasur-Landau 2018). That it was found in the water, outside its primary and secondary context, may support the idea that at least some of the finds in the North Bay are the result of the dismantling of Roman Dor in later periods. This idea is further elaborated on below and also by Gambash and Yasur-Landau (2018).

Activity Areas within the North Bay

The use of high-resolution underwater survey methods using GPS to pinpoint and record the location of each artifact has enabled us to identify spatial depositional patterns and distinguish different functional and temporal usages areas within the North Bay of Dor.

Table 5 Area C column drums

Group no.	Fig.	Reg. no.	Column diameter in cm	Depression shape	Depression size in cm
1	–	DNCOL15	90	Square	10*10
1	–	DNCOL16	95	Square	10*10
1	16.1	DNCOL17	90		
2	–	DNCOL11	80	Eroded and undefined	
2	–	DNCOL12	80	Eroded and undefined	
2	16.2	DNCOL13	80	Eroded and undefined	
2	16.2	DNCOL14	80	Eroded and undefined	
3	–	DNCOL8	70		
3	–	DNCOL9	70		
3	16.3	DNCOL10	70		
4	–	DNCOL21	80		
4	16.4	DNCOL22	90	Round	Diameter: 25
4	–	DNCOL23	70	Round	Diameter: 25
5	–	DNCOL5	50	Round	diameter: 15
5	16.5	DNCOL6	60	Round	Diameter: 15
5	–	DNCOL7	50	Round	Diameter: 15
6	16.6	DNCOL2	90		
6	–	DNCOL3	90		
6	–	DNCOL4	85		
–	16.7	DNCOL18	95		
–	–	DNCOL19	80		
–	–	DNCOL20	95		
–	–	DNCOL24	55	Round	Diameter: 5
–	–	DN213	55	Square	10*10
–	–	DN5			
–	–	DN351			

Maritime diver surveys deal by definition only with artefacts visible on the sea-floor, subject to wave energy, currents and shifting sediment cover. Where possible, these parameters need to be taken into account. In Areas A and C in the North Bay, the depositional patterns do not correlate well with waves, currents or sand coverage, thus supporting the reliability of the quantitative and qualitative results obtained there. Only Area B, with its sand-filled bowl-like bathymetry and relative dearth of ceramic finds, shows possible correlation between environmental conditions and data. Despite this, and despite it being much smaller in size than Area C, Area B produced the highest number of stone anchors, supporting its interpretation below as an anchoring spot. Large amounts of pottery in Area A—the entrance channel to the bay—may imply that the currents contributed to these depositions, and that the basic morphology of the bay has not changed in the last two millennia (Fig. 9).

Two distinct areas, Area B and Area C, were used for anchoring, but of different nature and chronological ranges. The first area, Area B, a small inlet located outside the entrance to the North Bay, yielded the largest concentration of anchors: six stone anchors possibly from the Bronze and Iron Ages and an early imperial Roman iron anchor. These were accompanied by a large concentration of pottery found mainly in the center of this

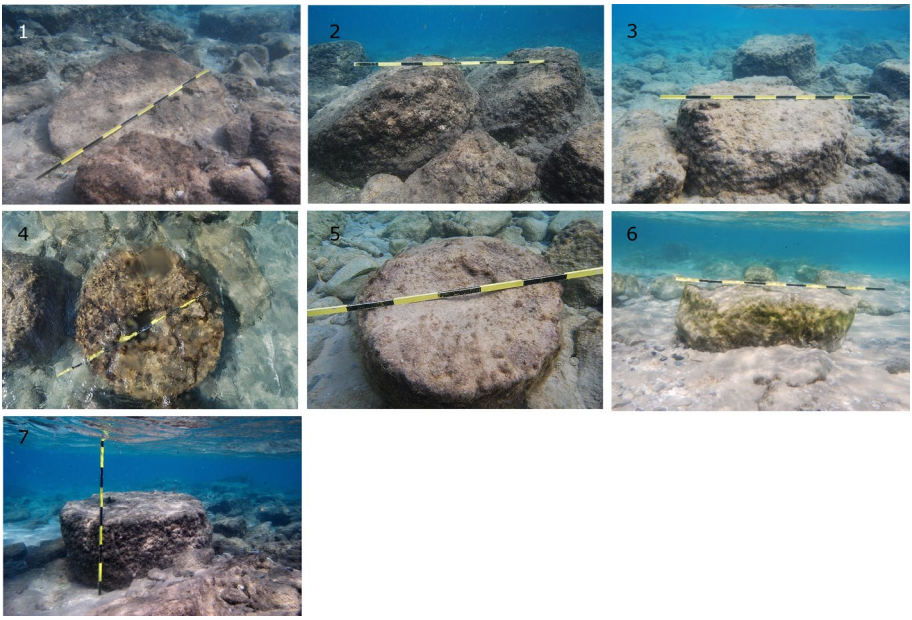

Fig. 17 Column drums from Area C (photos by E. Arkin Shalev)

inlet, dated from the Iron Age to the Byzantine period. This would seem to indicate that this small protected cove, deeper than the rest of the North Bay, was used for anchoring throughout different periods from the 2nd millennium BCE until at least the early 1st millennium CE. The need for deeper water for safer anchoring overcame the need for proximity to the city, as this cove is located at least 400 m to the north of the Bronze and Iron Age tell and at least 250 m from the northern extremity of the Roman and Byzantine towns. No coastal structures or maritime infrastructure are connected with this small anchorage.

The second area used for anchoring was Area C, covering the central and southwestern parts of the North Bay. The large quantity of pottery in this area testifies to the use of its southeastern part in the Late Roman (3rd–4th centuries CE in the local context) and Byzantine (4th–7th centuries CE) periods. The emphasis on ceramic shipping containers likely indicates that this was an area from which goods were brought into the city, perhaps using lighters or small vessels. The several concentrations of ballast stones likely indicate that the shallow water of the bay was used for the loading and unloading of ballast in order to stabilize the small crafts used in it. The amount of pottery found in this area drops sharply after the 7th century CE, coinciding well with the end of habitation at Tel Dor at the onset of the Early Islamic period (8th century CE) and the relocation of the site southward, to Tantura (Stern 1994: 322; Dauphin and Gibson 1994: 33). The connection between the Roman and Byzantine town boundaries and the maritime activity in the bay is demonstrated by the sharp contrast between Area C's intensive findspots and nearby coastal architecture and the near absence of finds from the bay's eastern half, paralleled by a complete lack of architecture on the coast. This connection between maritime activity in Area C and the nearby northern edge of the city in Area D was, however, not manifested in any significant built interface between land and sea. While the coastal structures as the large rectangular

Fig. 18 Reworked marble cornice (1a, 1b, 1c), stone table foot (2), and ceramic roof tiles (3a, 3b and 4a, 4b) (photos by E. Arkin Shalev)

structure and even the road to the sea reflected meticulous planning and large investment demonstrated by the use of ashlar masonry, the maritime infrastructure in the bay appears very light. It comprises mainly bollards (DN43 and DN44) and a mooring stone (DN 207) without a quay or pier. Wall W101 in Area D, previously interpreted as part of a basin complex where small freighters would anchor (Raban 1995: 295), did not function as a quay, but was rather a paved road, possibly related to other built features in its vicinity.

The columns and other architectural fragments found in the water do not belong to a structure in situ, but are rather associated with an activity of dismantling abandoned structures and monuments of Roman and Byzantine Dor, and the consequent shipping of stones and building material to another destination. Thus, for example, column drums of different diameters were grouped together on the waterline alongside building blocks. One of these concentrations included a statue base with the inscription of Gargilius Antiquus, a Roman governor of Judea in the 2nd century CE, thus indicating a reuse of elements from a dismantled civic monument (Gambash and Yasur-Landau 2018).

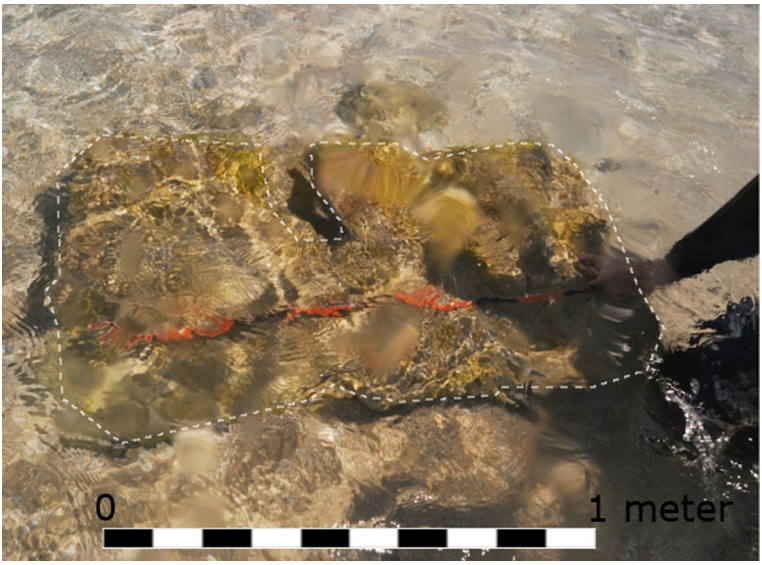

Fig. 19 Stone Bollard DN207 (photo by E. Nisenbaum)

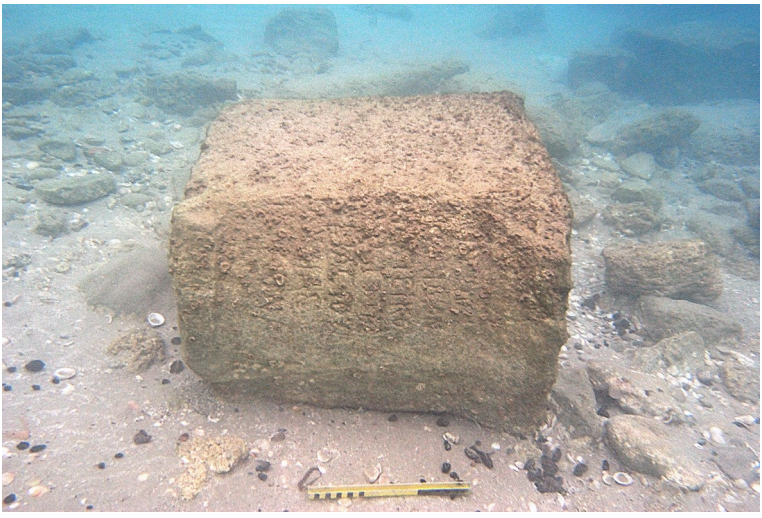

Fig. 20 Stone statue base and inscription (photo by E. Arkin Shalev)

Dor: A Port City Without a Harbor?

A diachronic comparison of the areas of the site inhabited during the Hellenistic, Roman, and Byzantine periods, as well as evidence for maritime activity in the various bays shows several discernible patterns, which are complemented by historical sources (Table 6):

Table 6 Main periods of usage and habitation at Dor, incorporating present and past research

	Hellenistic	Roman	Byzantine	Early islamic	Crusader	References
Tel Dor	α	α	B	–	α	Stern (1995), Sharon and Gilboa (2013) and Gilboa et al. (2015)
Lower Town	–	–	A	–	–	Stern and Sharon (1993: 128) and Dauphin and Gibson (1994)
Tantura Lagoon	–	–	Γ	γ	–	Kingsley and Raveh (1996), Kingsley (2002), Pomey et al. (2012) and Israeli and Kahanov (2014)
South Bay	γ	γ	Γ	–	–	Dauphin and Gibson (1994) and Raban 1995: 310–341). Raban identifies Late Bronze Age remains in the South Bay, which are now dated to the Iron Age (Arkin Shalev et al. Submitted for Publication; Lazar et al. 2017)
Love Bay	γ	γ	Γ	–	–	Dauphin and Gibson (1994), Raban (1995: 301–307)
North Bay	β	α, β, γ	α, β	–	β, γ	Raban (1995: 289–296)
Basilica	α	α	A	–	–	Dauphin (1997)

α = terrestrial architecture; β = ceramic evidence retrieved underwater and not associated with architecture; γ = anchors, sounding leads, shipwrecks, ballast piles; δ = built harbor structures; ε = textual sources

a. A rise in maritime activity during the Roman era is evidenced by the concurrent use of the South and North Bays.
b. The concurrent use of three out of the four bays and lagoons during the Byzantine era is tied to the first use of the Tantura Lagoon during this time, and is likely related also to the agricultural hinterland boom and connected to the location of the episcopal see at Dor.
c. The decline in maritime activity during the Early Islamic period is tightly connected with the movement of the site to the south and the founding of Tantura.
d. A modest recovery is seen in the Crusader period, following the construction of the small fort of Merle on the tell.

It is almost astonishing that throughout all periods (save perhaps the Iron Age), any major harbor infrastructure is missing. This stands in contrast to the nearby Caesarea, which yielded Hellenistic harbor remains and a grandiose Herodian harbor complex, followed by several phases of improvement of the maritime infrastructure in Roman and Byzantine times, which are evident in all the site's bays (Raban 1992: 7; Raban and Holum 1996: xxviii–xxxi). This difference cannot be attributed to differences in scale and resources alone. Flourishing Roman-era Dor became known as 'Ruler of the Seas' as boasted on locally issued coins (Meshorer 1995). The massive seaside Severan-era temples in excavation Areas F and H on the tell indicate that the Dor's decision makers were able to allocate the resources and labor needed for the erection of monumental coastal architecture (Nitschke et al. 2011: 147–151). Further major investment in resources and labor is reflected in other public buildings, such as a theatre and possibly a hippodrome and gymnasium (Stern 1994: 274, 295–296). It seems that the task of building a stone and concrete quay could not have been considered a serious challenge for those who constructed the massive ashlar and concrete walls of the Roman temple buildings. The same goes for the founders of Byzantine Dora, whose abilities to construct monumental architecture are well established by the town's massive basilica. Thus, the absence of substantial harbor works, save perhaps for a *horreum*, may be viewed as a conscious choice not to engage in this mode of construction, opting instead to use the naturally available coastal morphology, possibly augmented by modest docking features.

It is suggested here that this choice can be examined through a cost–benefit calculation. The existence of a well-maintained port is sometimes seen as a limiting factor in the existence of maritime connectivity and even in the carrying capacity of a post city. Thus, Preiser-Kapeller (2015: 7, fig. 5) presents a feedback model of the port city as a complex adaptive system wherein the port city and *umland* population impact sedimentation rates, presumably through deforestation or other mechanisms. This, in turn, negatively affects the port's activities, which, in turn, diminishes the carrying capacity of the city and *umland*; reversing this process requires an investment of effort by the population in dredging operations (ibid.: figs. 10, 11) and other forms of maintenance. This approach is tightly connected to the evolutionary approach to harbor architecture, whereby it is possible to trace the technological progression of the harbor and its infrastructure via evidence of marine structures, as well as various proxy markers, beginning with proto-harbors of the Bronze and Iron Ages and culminating with built harbors in the Hellenistic and Roman and later periods (e.g., Marriner et al. 2014: 4, fig. 3). An implicit (and sometimes explicit) assumption embedded within this evolutionary approach is that more advanced harbor installation have technical and therefore economic benefits.

In reality, innovative harbor construction methods were not always technically superior nor did they always yield considerable commercial advantages. Rather, harbors were sometimes constructed and maintained for their symbolic value. The harbor of the main bay of Caesarea was not needed only for its anchoring abilities, which diminished in the 2nd century CE; it also had a symbolic value as the main gateway of the Roman and later Byzantine province of *Palaestina*, and it was thus restored by the emperor Anastasius (492–517 CE) (Raban and Holum 1996: xxviii–xxxi). It may well be that Caesarea could have done with much less infrastructure, as evidenced by the maritime finds in its south bay, attesting to flourishing maritime activity with minimal maritime infrastructure of a light wooden quay (Ratzlaff et al. 2017: 128–129). The plurality of harbors in Roman and Byzantine Caesarea was not necessarily chiefly the result of plurality of maritime construction projects, but rather a result of the natural circumstances of being located adjacent to three natural bays (Ratzlaff et al. 2017: 128). Dor with its four bays was never the seat of a Roman or Byzantine governor on the one hand. On the other hand, thanks to this, it was not burdened with the duty of maintaining a maritime heritage as did post-Herodian Caesarea. The four bays were deemed sufficient for the needs of maritime transportation, as their different openings allowed anchoring in at least one of them in any weather. The inconvenience of anchoring 400 m or more south of the city in the case of the Tantura Lagoon or 250 m north of the city in the case of the northern part of the North Bay calculated easily against the massive costs of constructing a harbor, repairing it after storm damage, and conducting other costly maintenance activities.

The port of Dor presents a different paradigm, requiring a different model—one in which infrastructure is minor or completely missing and therefore cannot decay, silt out, or submerge. The harbor activities took place in several different bays that offered solutions for varying weather conditions, thanks to their different morphologies and the protection levels they offered. This pattern of use had an additional advantage of offsetting the effects of sedimentation on the bay areas, as the main sediment deposition in the micro-region is the nearshore longshore current-driven transport of Nilotic sand, rather than the deposition of alluvial sediment aggravated by anthropogenic effects (Zviely et al. 2007). The energy expenditure needed to maintain the carrying capacity of the port and *umland* would have therefore been greatly diminished, and there was no longer a zero-sum game between the need to renew infrastructure and the imminent danger of loss of use of harbor; instead there was flexibility and adaptability in the use of multiple bays. The result was a low-risk, high-yield adaptation to the coastal environment that was nonetheless effective enough to service the needs of a large (for the region) Roman city—the so-called Ruler of the Seas—and later of a Byzantine town acting as a gateway to a booming agricultural hinterland. Yet given that starting from the first quarter of the 1st millennium BCE and lasting until the Early Muslim conquest of Palestine no major harbor works existed at Dor, the resultant driving force would have been not an evolutionary process, but a seemingly disheveled, yet conscious, efficient, and ultimately effective use of the natural geomorphology, possibly driven by long-lasting cultural agents. As the evidence clearly shows that, as early as the Iron Age, both technology and resources were readily available, but not put to use in building a centralized, resource-heavy harbor. In fact, the use of a natural bay with minimal modifications as a proto-harbor (Marriner et al. 2014) in the Mediterranean basin did not stop even after the Pheonician invention of harbor ashlar constructions or widespread use of built harbor infrastructure in the Hellenistic and Roman periods. Thus, even in Carthage, a major maritime power, significant harbor infrastructure was not developed before the late Punic period (3rd century BCE) and around the middle of the 1st millennium BCE, anchoring was conducted there in a natural lagoon, where ships were likely hauled onto the

natural beach, east of the Tophet (Gifford et al. 1992). In Elaia, the Hellenistic port of Pergamon, the beach was used for anchoring from the 3rd century BCE, with minimal modification, no quays or breakwaters, and only a single large structure, possibly a shipshed was found in the open harbor (Seeliger et al. 2019: 14), another harbor of the same site (Pint et al. 2015). At Utica, the coast of the north part of the bay was used as a harbor basin from the 4th century BCE to the 6th century CE despite progressing alluvial infilling, probably without much infrastructure (Delile et al. 2015). Finally, as mentioned above, the southern anchorage in Caesarea employed minimal infrastructure during the Late Roman period, including onlyeither mooring stones and a light wooden structure, while most docking activity was conducted in the natural bay (Ratzlaff et al. 2017).

The study of the anchorages of the Roman and Byzantine city of Dor thus provide valuable insight into the diverse ways in which the challenges of creating, governing, and maintaining maritime interfaces in the eastern Mediterranean were met, and how they may have changed over time. Leidwanger (2013a) associates 'opportunistic ports'—anchorages lacking stone-built facilities—with the expanding rural settlement of late antiquity eastern Cyprus. It is proposed that such a built/opportunistic dichotomy may be expanded to include and describe a plurality of approaches that utilize multiple interfaces coexisting spatially and temporally, involving varying degrees of infrastructure. Rather than reflecting only the limits of the economic needs and means of a rural society, such ports and anchorages may result from a conscious choice by the decision makers of an urbanized locale or by parts of its populace, leading to a multiplicity of approaches even within the same harbor complex.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Anzidei M, Antonioli F, Benini A, Lambeck K, Sivan D, Serpelloni E, Stocchi P (2011) Sea level change and vertical land movements since the last two millennia along the coasts of southwestern Turkey and Israel. Quat Int 232(1):13–20

Arkin Shalev E, Gilboa A, Sharon I, Yasur-Landau A (2017) Iron Age coastal structures at Tel Dor: results of the 2016 and 2017 underwater excavation seasons, paper presented at the Association of Oriental Schools Annual Meeting, Boston, 2017

Ballard R, Stager L, Master D, Yoerger D, Mindell D, Whitcomb L, Singh H, Piechota D (2002) Iron Age shipwrecks in deep water off Ashkelon, Israel. Am J Archaeol 106(2):151–168

Barkan D, Yasur-Landau A, Mommsen H, Ben-Shlomo D, Kahanov Y (2013) The 'Dor 2006' shipwreck: the ceramic material. Tel Aviv 40:117–143

Bikai P (1978) The pottery of Tyre. Aris and Phillips, Warminster

Blackman DJ (1982) Ancient harbours in the Mediterranean, part 1. Int J Naut Archaeol Underw Explor 11(2):79–104

Blakely J (1988) Ceramics and commerce: amphorae from Caesarea Maritima. Bull Am Sch Orient Res 271:31–50

Bonnie R (2017) From stadium to harbor: reinterpreting the curved ashlar structure in Roman Tiberias. Bull Am Sch Orient Res 377:21–38

Conder C, Kitchener H (1993) The survey of western Palestine, volume II. The committee of the Palestine Exploration Fund, LondonDauphin C (1993) Dora-Dor: a station for pilgrims in the Byzantine period on their way to Jerusalem. In: Tsafrir Y (ed) Ancient churches revealed. Israel Exploration Society, Jerusalem, pp 90–97
Dauphin C (1997) Dor, Byzantine church. Isr Explor J 47(1):121–127
Dauphin C, Gibson A (1994) The Byzantine city of Dor/Dora discovered. Bull Anglo-Isr Archaeol Soc 14:9–37
Delile H, Abichou A, Gadhoum A, Goiran JP, Pleuger E, Monchambert JY, Wilson A, Fentress E, Quinn J, Ben Jerbania I, Ghozzi F (2015) The geoarchaeology of Utica, Tunisia: The paleogeography of the Mejerda Delta and hypotheses concerning the location of the ancient harbor. Geoarchaeology 30(4):291–306
Ellenblum R (2007) Crusader castles and modern histories. Cambridge University, Cambridge
Frost H (1963) From rope to chain—on the development of anchors in the Mediterranean. Mariner's Mirror 49(1):1–20
Gambash G, Yasur-Landau A (2018) 'Governor of Judea and Syria': a new dedication from Dor to Gargilius Antiquus. Zeitschrift für Papyrologie und Epigraphik 205:158–164
Gianfrotta P (1996) Harbor structures of the Augustan age in Italy. In: Raban A, Holum K (eds) Caesarea Maritima: a retrospective after two millennia. Brill, Leiden, pp 65–76
Gibson S, Kingsley S, Clarke J (with appendices by Rowan Y, Finkeilsztejn G, Hawari M, Auld S) (1999) Town and country in the southern Carmel: report on the Landscape Archaeology Project at Dor (LAPD). Levant 31:71–121
Gifford JA, Rapp G Jr, Vitali V (1992) Palaeogeography of Carthage (Tunisia): coastal change during the first millennium BC. J Archaeol Sci 19(5):575–596
Gilboa A (2015) Dor and Egypt in the early Iron Age: an archaeological perspective of (part of) the Wenamun Report. Egypt Levant 25:247–274
Gilboa A, Waiman-Barak P, Sharon I (2015) Dor, the Carmel coast and early Iron Age Mediterranean exchanges. In: Babbi AF, Bubenheimer-Erhart B, Marín-Aguilera B, Mühl S (eds) The Mediterranean mirror: cultural contacts in the Mediterranean Sea between 1200 and 750 B.C. Römisch-Germanisches Zentralmuseum, Mainz, pp 85–109
Grace V (1965) The commercial amphoras from the Antikythera shipwreck. Trans Amer Philos Soc 55(3):5–17
Grossmann E, Kingsley SA (1996) Three-hole stone anchor with wood remains from Crusader Arsuf (Apollonia), Israel. Int J Naut Archaeol 25(1):49–54
Guérin V (1984) Description géographique, historique et archéologique de la Palestine, tome II. Trans. into Hebrew by Ben-Amram H. Yad Ben-Zvi, Jerusalem
Haddad E (2009) Roman Byzantine amphorae from a terrestrial site and its underwater environs: Horbat Castra and Kfar Samir (southern Levant) as a case study. Levant 41(1):79–91
Hadjidaki E (1996) The Hellenistic harbor of Phalasarna in western Crete: a comparison with the Hellenistic inner harbor of Straton's Tower. In: Raban A, Holum K (eds) Caesarea Maritima: a retrospective after two millennia. Brill, Leiden, pp 53–64
Heath S, Tekkök B (eds) (2006–2009) Greek, Roman and Byzantine pottery at Ilion (Troia). Retrieved March 9th 2014 from http://classics.uc.edu/troy/grbpottery/
Hirschfeld Y (2004) A climatic change in the early Byzantine period? Some archaeological evidence. Palest Explor Quart 136(2):133–149
Holdman A (2017) Provenance studies of the ballast stones found in the North Bay of Tel Dor, Israel. MA thesis, University of Haifa, Haifa
Horden P, Purcell N (2000) The corrupting sea: a study of Mediterranean history. Blackwell, Oxford
Israeli E, Kahanov Y (2014) The 7th–9th century Tantura E shipwreck, Israel: construction and reconstruction. Int J Naut Archaeol 43(2):369–388
Johnson B (2008) The pottery. In: Patrich J (ed) Caesarea Maritima Areas CC, KK and NN final reports. Israel Exploration Society, Jerusalem, pp 19–206
Kahanov Y, Mor H (2013) The Dor 2001/1 Byzantine shipwreck: final report. Int J Naut Archaeol 43:41–65
Kapitän G (1984) Ancient anchors—technology and classification. Int J Naut Archaeol 13(1):33–44
Keay S (1984) Late Roman amphorae in the western Mediterranean. BAR International Series 196(i). Archaeopress, Oxford
Kempinski A (2002) Tel Kabri the 1986–1993 Excavation Seasons. Emery and Claire Yass Publications in Archaeology, Tel Aviv
Kingsley S (2001) Decline of the ports of Palestine in late antiquity. J Roman Archaeol Suppl Ser 42:69–88
Kingsley S (2002) A sixth-century AD shipwreck off the Carmel coast, Israel: Dor D and Holy Land wine trade. British Archaeological Reports 1065. Archaeopress, Oxford

Kingsley S (2003) The Dor D shipwreck and Holy Land wine trade. Int J Naut Archaeol 32(1):85–90
Kingsley S, Raveh K (1994) A reassessment of the northern harbour of Dor, Israel. Int J Naut Archaeol 23(4):289–295
Kingsley S, Raveh K (1996) The ancient harbour and anchorage at Dor, Israel: result of the underwater surveys 1976–1991. Tempus Reparatum, Oxford
Laiou A, Morrison C (2007) The Byzantine economy. Cambridge University Press, Cambridge
Lazar M, Engoltz K, Basson U, Yasur-Landau A (2017) Water saturated sand and a shallow bay: combining coastal geophysics and underwater archaeology in the south bay of Tel Dor. Quat Int 473:112–119
Leibovitz J (1950) Dor. Isr Explor J 1:249
Leidwanger J (2007) Two Late Roman wrecks from southern Cyprus. Int J Naut Archaeol 36(2):308–316
Leidwanger J (2013a) Opportunistic ports and spaces of exchange in Late Roman Cyprus. J Marit Archaeol 8(2):221–243
Leidwanger J (2013b) Between local and long-distance: a Roman shipwreck at Fig Tree Bay off SE Cyprus. J Roman Archaeol 26:191–208
Levine L (1975) Roman Caesarea an archaeological-topographical study. Qedem 2:1–56
Magness J (2003) The archaeology of the Early Islamic settlement in Palestine, vol 1. Eisenbrauns, Winona Lake
Marriner N, Morhange C, Kanieewski D, Carayon N (2014) Ancient harbour infrastructure in the Levant: tracking the birth and rise of new forms of anthropogenic pressure. Sci Rep 4:1–11
Mayerson P (1985) The wine and vineyards of Gaza in the Byzantine period. Bull Am Sch Orient Res 257:75–80
Mayerson P (1993) The use of Ascalon wine in the medical writers of the fourth to the seventh centuries. Isr Explor J 43:169–173
McCaslin D (1980) Stone anchors in antiquity: coastal settlements and maritime trade-routes in the eastern Mediterranean ca. 1600–1050 B.C. Studies in Mediterranean Archaeology LXI. Åström, Gothenburg
Meshorer Y (1995) The coins from of Dora. In: Stern E, Berg J, Gilboa A, Guz-Zilberstein B, Raban A, Rosenthal-Heginbottom R, Sharon I (eds) Excavations at Dor, final report, vol. 1A: Areas A and C: introduction and stratigraphy. Qedem Reports 2. Jerusalem, pp 355–365
Mor H, Kahanov Y (2006) The Dor 2001/1 Shipwreck, Israel: a summary of the excavation. Int J Naut Archaeol 35:274–289
Nitschke J, Martin R, Shalev Y (2011) Between the Carmel and the sea: Tel Dor: the late periods. Near East Archaeol 74(3):132–154
Nun M (1993) Ancient stone anchors and net sinkers from the Sea of Galilee. Kibbutz Ein Gev, Ein Gev
Patrich J (2011) Studies in the archaeology and history of Caesarea Maritima: caput Judaeae, metropolis Palaestinae. London
Peacock DSP, Williams DF (1986) Amphorae and the Roman economy. Longman, London
Pieri D (2012) Regional and interregional exchanges in the eastern Mediterranean during the Early Byzantine period: the evidence of amphorae. In: Morrisson C (ed) Trade and markets in Byzantium: Dumbarton Oaks Byzantine symposia and colloquia 4. Washington, DC, pp 27–49
Pint A, Seeliger M, Frenzel P, Feuser S, Erkul E, Berndt C, Klein C, Pirson F, Brückner H (2015) The environs of Elaia's ancient open harbour—a reconstruction based on microfaunal evidence. J Archaeol Sci 54:340–355
Pomey P, Kahanov Y, Rieth E (2012) Transition from shell to skeleton in ancient Mediterranean shipconstruction: analysis, problems, and future research. Int J Naut Archaeol 41(2):235–314
Preiser-Kapeller J (2015) Harbours and maritime networks as complex adaptive systems: a thematic introduction. In: Preiser-Kappeler J, Daim F (eds) Harbours and maritime networks as complex adaptive systems. Schnell and Steiner, Mainz, pp 1–23
Pulak C (1998) The Uluburun shipwreck: an overview. Int J Naut Archaeol 27(3):188–224
Raban A (1990) Medieval anchors from the Red Sea. Int J Naut Archaeol 19(4):299–306
Raban A (1992) In search of Straton's tower. In: Vann R (ed) Caesarea papers: Straton's tower, Herod's harbour, and Roman and Byzantine Caesarea. Journal of Roman Archaeology, Supplementary Series 5. Ann Arbor, pp 7–22
Raban A (1995) Dor-Yam: Maritime and coastal installations at Dor in their geomorphological and stratigraphic context. In: Stern E, Berg J, Gilboa A, Guz-Zilberstein B, Raban A, Rosenthal-Heginbottom R, Sharon I (eds) Excavations at Dor, final report, vol. 1A: Areas A and C: introduction and stratigraphy. Qedem Reports 2. Jerusalem, pp 286–354
Raban A, Galili E (1985) Recent maritime archaeological research in Israel: a preliminary report. Int J Naut Archaeol 14(4):321–356

Raban A, Holum K (1996) Introduction. In: Raban A, Holum K (eds) Caesarea Maritima: a retrospective after two millennia. Brill, Leiden, pp xxvii–xliv

Ratzlaff A, Galili E, Waiman-Barak P, Yasur-Landau A (2017) Beyond Sebastos: the plurality of harbors at Caesarea. J Marit Archaeol 12:125–146

Reynolds P (2005) Levantine amphorae from Cilicia to Gaza: a typology and analysis of regional production trends from the 1st to the 7th centuries. In: Esparraguera J, Garrigos J, Ontiveros M (eds) LRCW1 Late Roman coarse wares, cooking wares and amphorae in the Mediterranean: archaeology and archaeometry. BAR International Series 1340. Archaeopress, Oxford, pp 563–612

Reynolds P (2013) Transport amphorae of the first to seventh centuries: early Roman to Byzantine periods. In: Aylward W (ed) Excavations at Zeugma, vol II. The Packard Humanities Institute, Los Angeles, pp 93–161

Rickman G (2002) Rome, Ostia and Portus: the problem of storage. Mélanges de l'École française de Rome 114(1):353–362

Riley J (1975) The pottery from the first session of excavation in the Caesarea hippodrome. Bull Am Sch Orient Res 218:25–63

Riley J (1979) Coarse pottery from Berenice. In: Lloyd J (ed) Excavations at Sidi Khrebish, Benghazi (Berenice), II, Supp. to Libya Antiqua V, Tripoli, pp 91–467

Seeliger M, Pint A, Feuser S, Riedesel S, Marriner N, Frenzel P, Pirson F, Bolten A, Brückner H (2019) Elaia, Pergamon's maritime satellite: the rise and fall of an ancient harbour city shaped by shoreline migration. J Quat Sci. https://doi.org/10.1002/jqs.3091

Sharon I, Gilboa A (2013) The SKL town: Dor in the Early Iron Age. In: Killebrew A, Lehmann G (eds) The Philistines and other "Sea Peoples" in text and archaeology. Society of Biblical Literature, Atlanta, pp 393–468

Sivan D, Lambeck K, Toueg R, Raban A, Porath Y, Shirman B (2004) Ancient coastal wells of Caesarea Maritima, Israel: an indicator for relative sea level changes during the last 2000 years. Earth Planet Sci Lett 222(1):315–330

Stern E (1994) Dor, ruler of the seas: twelve years of excavations at the Israelite-Phoenician harbor town on the Carmel Coast. Israel Exploration Society, Jerusalem

Stern E (1995) Historical conclusions. In: Stern E, Berg J, Gilboa A, Guz-Zilberstein B, Raban A, Rosenthal-Heginbottom R, Sharon I (eds) Excavations at Dor, final report, vol. 1A: Areas A and C: introduction and stratigraphy. Qedem Reports 2. Jerusalem, pp 271–284

Stern E (2012) Akko I: the 1991–1998 excavations. the Crusader-period pottery, part 2: plates. Israel Antiquities Authority, Jerusalem

Stern E, Sharon I (1993) Tel Dor, 1992: preliminary report. Isr Explor J 43(2/3):126–150

Stern E, Berg J, Gilboa A, Sharon I, Zorn J (1997) Tel Dor, 1994–1995: preliminary stratigraphic report. Isr Explor J 47(1):29–56

van Alfen G (1996) New light on the 7th c. Yassi Ada shipwreck: capacities and standard sizes of the LRA 1 amphoras. J Roman Archaeol 9:198–213

Waksman S, Morozova Y, Zelenko M, Colak M (2014) Archaeological and archaeometric investigations of the amphorae cargo of a Late Roman shipwreck sunk near the Cape of Plaka (Crimea, Ukraine). In: Poulou-Papadimitriou N, Nodarou E, Kilikoglou V (eds) LRCW4: Late Roman coarse wares, cooking wares and amphorae in the Mediterranean. Archaeology and archaeometry: the Mediterranean, a market without frontiers. BAR International Series 2616(I). Archaeopress, Oxford, pp 919–930

Yahalom-Mack N, Galili E, Segal I, Eliyahu-Behar A, Boaretto E, Shilstein S, Finkelstein I (2014) New insights into Levantine copper trade: analysis of ingots from the Bronze and Iron Ages in Israel. J Archaeol Sci 45:159–177

Yasur-Landau A, Arkin-Shalev E, Zajac P, Gambash G (2018) Rethinking the anchorages and harbours of the southern Levant 2000 BC–600 AD. In: Von Carnap Bornheim C (ed) Harbours as objects of interdisciplinary research. Verlag des Römisch-Germanischen Zentralmuseums, Mainz, pp 73–89

Zviely D, Kit E, Klein M (2007) Longshore sand transport estimates along the Mediterranean coast of Israel in the Holocene. Mar Geol 238:61–73