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New Dating and Contextual Evidence for the Fragmentary Timber Remains Located in the Dor D Site, Israel

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The laboratory report for a wood-sample taken from one of the ship-timbers discovered at the Dor D site for C14 analysis is completed. This dating result indicates a potential revision for the group of timbers in this deposit and, consequently, new chronological contexts for their construction characteristics. Subsequent excavation and survey in the lagoon has resulted in a revised interpretation for the components of the Dor D deposit. Taken together, this new dating and contextual evidence helps to clarify what these timbers can and cannot contribute to the understanding of trends in ship construction.

Key words: Nautical archaeology, ship construction, Dor D, Tantura lagoon, site-formation.

During the authors' excavation and recording of the timber remains from the Dor D area of Tantura Lagoon in 1999, a sample was taken from a timber for C14 dating analysis. This is the second sample from the group of timbers, the first one taken during the initial survey (Kingsley and Raveh, 1996: 65). The date from this more recent sample is divergent from previously-reported dates. Additionally, subsequent excavation and survey work in the lagoon through 2004 has shed new light on the interpretation of the Dor D site's formation processes and the inter-relationship of its individual components (although Dor D itself was not re-excavated). This new dating and contextual evidence for the timbers necessitates a new contextualization of the construction features and the contribution this evidence makes to archaeological research.

Modern Tantura Lagoon is a small bay partially protected by four small offshore islands, and bordered to the north by a promontory where the site of Tel Dor lies (Fig. 1). Evidence suggests that it has served as a natural harbour for vessels of numerous cultures for more than 3000 years. Despite the partial land barriers, this bay is subject to open-sea storms that alternately remove, deposit, and redistribute sand.[1] There is also a north-south current that maintains a cut through the bay, providing a navigable passage for small fishing vessels. Hence the sea-floor is in a perpetual state of flux and almost certainly has been for millennia. Within this environment, submerged cultural remains are periodically exposed and sometimes moved before being re-covered. The area designated as the Dor D site is located near numerous other previously-investigated sites within the bay, and lay beneath 2 m of water at the time of excavation. The timbers that comprise Dor D consisted of 14 fragmentary hull-planks situated within a matrix of sand, shells, ceramic fragments, and stones; no other ship-timbers such as a keel, frames, or posts were found in the immediate area. A generous estimate of the total area of planking-timber represented is approximately 4 m^2, with only two timber fragments over 3 m long; eight of the 14 timbers were 2 m or less in length. Ceramic fragments and stones were located throughout the site both atop and beneath the timbers.

Site-formation reassessment

Since the excavation of the Dor D site, much has been learned about site-formation in the Tantura Lagoon. Subsequent work includes the excavation

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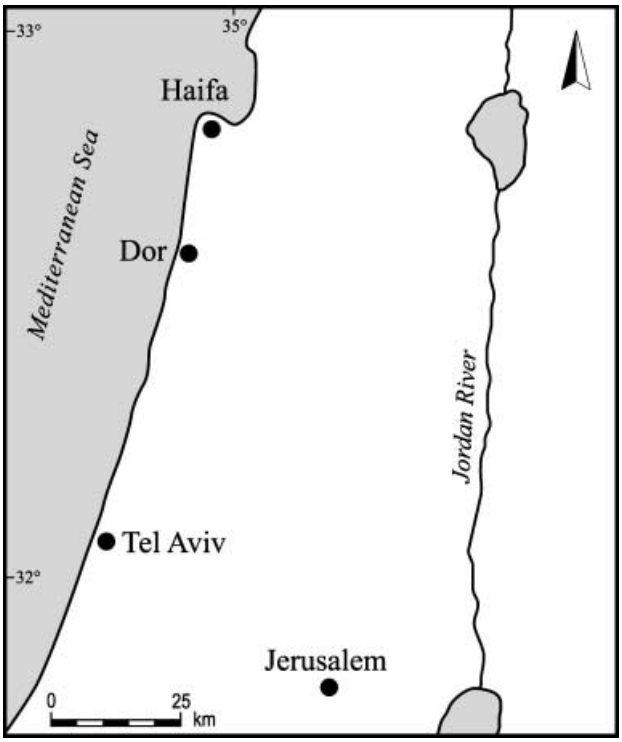

Figure 1. Location map.

of five wreck-sites (Dor C, DW2, Dor 2001/1, Dor 2002/2, and Tantura F), the digging of numerous test-trenches, and probe-surveys, which were carried out between 2000 and 2004. Using a water-jet probe; entries were made every 1 m on grids situated generally north-west of Dor D. Based on this more recent research in the lagoon, the site-formation processes for each of the artefact groups is much clearer.

As stated in a previous article (Kahanov and Royal, 2001: 257–8), the 14 planking-timbers were in varying degrees of degradation and had shell-impressions on their upper surfaces, all of which suggest episodes of intermittent burial and exposure. These planks varied in their orientation, for example planks 13–14 lay perpendicular and *c.*100–150 mm deeper than planks 1–5. Given the disjointed position of many planking fragments and the variation in their depths, it cannot be concluded that they all originated from the same vessel. However, the similarity in construction and fastening characteristics exhibited by all of these planking-timbers, discussed below, and their proximity to one another, supports their having originated from a single vessel (Kahanov and Royal, 2001). Therefore, this will be the premise for further discussion.

A mixture of amphora and other sherds, their dates spanning a millennium, as well as modern roofing tiles, was found throughout the Dor D site. The pottery was mainly Late Byzantine, often mixed with sherds dating to the 5th century BC.[2] Ceramic fragments were found above, between, and beneath the timbers.[3] Excavation and survey results subsequent to the 1999 season indicate that the ceramic deposit continues roughly in a north-north-westerly direction for at least another 150 m, and probably further. Indeed, similar ceramic deposits were noted in every area of the lagoon thus far explored from 1994 to 2004. This sherd-scatter was found across each of the excavations and surveys conducted through 2004, including the Tantura A and B sites and trenches IV, VII, and IX, all of which were excavated prior to 1999, as well as Trench 9, Dor 2001/1, and Tantura F excavated later (Carmi and Segal, 1995; Sibella, 1995; Kahanov and Royal, 1996; Kahanov, 1997; Royal and Kahanov, 2000; Mor, 2002). Although unpublished, a similar mixture of sherds was discovered during the excavation of the 5th-century BC Ma'agan Mikhael wreck-site located approximately 9 km south of Tantura lagoon. It is not yet determined how far the ceramic deposit extends from the Dor D site in other directions. With the primary current moving in a southward direction, it seems unlikely that the Dor D site represents the southern limit of this ceramic deposit. However, during particularly high seas, waves enter from the south-west contra the current inside the lagoon. These ceramic clusters apparently exist also in the northern bay of Tantura lagoon, just to the south of Tel Dor, now disconnected by a tombolo.

No grids or reference points for spatial or depth controls were employed during the collection of sherds at the Dor D site. The only reference points were utilized in the process of timber recording. Furthermore, numerous ceramic sherds remained under and around the site throughout the excavation period, and had not been recovered by the time of post-excavation reburial. The limited conclusions that can be drawn thus far from ceramic finds in Tantura Lagoon are that a significant amount of Byzantine activity, shipping and material probably passed through this anchorage. Due to the relatively ubiquitous nature of the ceramic deposits, and the continual movement to which they are subject, these cannot provide evidence for the dating or provenience of the Dor D timbers.

Tantura Lagoon has a complex set of circumstances affecting the interpretation of stone finds. The northern border of the bay is Tel Dor, which

has endured numerous episodes of construction, destruction, and later archaeological excavation. Ancient fragments of Kurkar stone, a coarse calcareous sandstone once quarried in the area, are largely discernable all over the area as well. It is unclear how much stone debris has moved through the bay along the north-south current. There are at least two ancient vessels that appear to have been carrying stone as some or all of their cargo, including the late-Byzantine stone-carrier undergoing excavation since 2002 (Mor, 2002; Mor, 2004). Another notable problem in the interpretation of stone finds is the roughly 2-m-high sea-wall built in the 1950s that extends across the protecting islands. It acts as the primary defence against wave-surge and has subsequently lost many of its stones into the lagoon during storms, and fragments are found throughout the bay. Stones mixed with Byzantine pottery and wood remains were also found in trench IX, or Tantura E (Wachsmann and Kahanov, 1997), and trench X or Tantura F (Wachsmann *et al.*, 1997: 12, fig. 18).

Numerous stones, inter-mixed with the pottery sherds, were recovered adjacent to the timbers at the Dor D site. They were found beneath and above the timber fragments, and did not meet the requirements of rudimentary shape, isolated context, or physical attributes typically associated with ballast used on small vessels engaged in cabotage.[4] Furthermore, the water-jet probe survey in 2000 located stone deposits of varying concentrations in numerous areas, including to the north and west of the Dor D site. Based on the corpus of investigations since 1994, the formation and pattern of the stone deposit in and around the site area appears to have been dictated mainly by the current and storm action. Thus, they cannot be differentiated from other areas of randomly-scattered stones in the lagoon, where clusters of closely-accumulated stones exist in many locations.

Taken as a whole, the evidence may even suggest that the planking fragments were not in their original wreckage location. The timbers lay in a scattered pattern, had undergone exposure and reburial, and were mixed within a jumble of ceramics and stone common throughout the lagoon. From this, one may conclude that the Dor D site has the characteristics of material washed into a collection area. This collection area is by no means permanent, and could, as a result of storm surge, be swept into a similar association elsewhere in the bay. Artefacts in such active harbour and channel environments tend to migrate and settle in low-energy, depressed areas which form collection-pockets or flows. As a result they are often re-deposited in an unarticulated and jumbled pattern. These collection areas often possess artefacts from numerous sites as well as artefacts discarded overboard as refuse or by accident, or deposited in the same general area at different times.[5] The constant currents and repeated storm-surges explain the presence of pottery fragments ranging in date from the 5th century BC to the 7th century AD, stone anchors that have parallels in the Iron Age, and modern ceramic tile fragments at one particular site level (see also Wachsmann and Kahanov, 1997: 10). These fragmentary planking timbers were most probably torn from a shipwreck and deposited in this collection-area. This would also explain the lack of other types of hull-timbers found with them.

Shell-impressions were largely discernable on upper plank surfaces of Dor D, apparently as a result of stone pressure on the shells situated on the wood. Thus, the shells were probably deposited on the timbers before the stones, and therefore the stone context is questionable. Consequently, there is no confidence in the depositional relationship between the timber remains and the ceramic sherds or stones at the Dor D site other than a confluence due to taphanomic processes. There are, however, limited contributions these planking-timbers can offer to the development of ship-construction once a more accurate operational date-range is established.

Dating reassessment

During the initial survey of the timbers at Dor D, a single wood-sample was taken for C14 analysis. The report does not specify the exact timber from which this sample was taken. The previously-reported mean date for this sample was 1490 BP, which suggests a calibrated date range of 539–621 AD (RT 1539) (Kingsley and Raveh, 1996: 65). A critical piece of evidence concerning the timbers was noted in the earlier article describing the timber remains; a second wood sample was to be collected for C14 analysis (Kahanov and Royal, 2001). The new sample, taken from Plank 7 (Kahanov and Royal, 2001, fig. 3) provides a date of 1635 ± 30 BP, and calibrated range of 350–370 AD (3.8%), 380–440 AD (56%), 450–530 AD (8.4%) (RT 4613) (Boaretto, 2004). Plank 7 was selected due to the fact it did not appear in the initial survey description or photographs, thus avoiding sampling from the same timber. This new

sample suggests a date earlier than the authors' previous 'working date' of the middle of the 7th century AD (Kahanov and Royal, 2001). The mean dates for the two samples, 1490 BP (1995) and 1635 BP (2004), are 145 years apart, while the calibrated mean dates of 580 AD (1995) and 410 AD (2004) are 170 years apart. Both C14 sample dates were averaged by the laboratory and resulted in a date of 1584 ± 24 BP, with a calibrated date range of 430–540 AD (pers. comm. Boaretto, 22 April 2004). Although the overall C14 dating results spans from 350–621 AD, the average provided from the laboratory gives a working date of the mid 5th to mid 6th centuries AD. Based on the survey and excavations carried out over the past decade, reassessment of site-formation and natural processes in the lagoon, the only reliable dating evidence available for the timbers located at the Dor D site, as with other sites in the lagoon, is that provided by C14 samples from the available wood remains themselves except in definite *in situ* finds or other available organic materials.

Contribution to ship construction

The new dating evidence suggests the Dor D timbers originated from a vessel that probably operated between the mid-5th and mid-6th century AD. With an increased awareness of the complexity of site-formation processes in Tantura lagoon, the authors feel compelled to reiterate that the conclusions drawn from this site are limited. The only direct information provided by these fragmentary planking-timbers is planking thickness and some frame-plank and plank-plank attachment types. Unpegged mortise-and-tenon joints were used between strake edges, a pegged mortise-and-tenon joint was found joining two planks in a strake scarf, and both nails and treenails were used as frame-plank attachments. This direct evidence is, however, limited by not having any way conclusively to determine the location(s) within the original hull for these timbers. Such information is pertinent, for example, in understanding the spacing of mortise-and-tenon joints, as their intervals often vary between bow or stern and amidships. For example, the 7th-century Yassiada vessel had mortises spaced more closely at the stern than at midships (Bass and van Doorninck, 1982: 55).

The planking-timbers also possessed indirect evidence for the sided dimensions of frames, 108 mm on average, and the spacing of frame stations, 229 mm on average (Kahanov and Royal, 2001). Frame-plank attachments, staining patterns, and score-marks combined to provide the basis for these inferences. However, without extant frame timbers to examine, their aspect-ratio, cross-sectional area, floor/half-frame pattern, and attachment relationship to the keel and futtocks is unavailable. Thus an immense amount of data absolutely critical to a genuine understanding of the construction-sequence and vessel-size is unattainable. Consequently, it is a serious overstatement of the available evidence to posit an accurate indication of a vessel's dimensions derived solely from these planking fragments. This was the basis for the authors' caveat that 'sufficient evidence for certainty is lacking' in regards to the dimensions of the shipwreck from which these timbers originated (Kahanov and Royal, 2001: 264).

Unpegged mortise-and-tenon joints were found on every planking edge and were spaced on average 286 mm centre-to-centre. The 3–5-mm-thick oak tenons typically filled 60% of their mortises' width. In regard to the revised dating of the fragmentary timbers, there are tentative implications for the use of mortise-and-tenon joints. Mediterranean vessels from the 2nd to 4th centuries typically had pegged mortise-and-tenon joints, except for the Fiumicino 1 and 2 vessels, which had a few unpegged joints. Previously, insufficient representation of remains has prevented an understanding of mortise-and-tenon joints in the 5th century AD, but fastening evidence for the 6th and 7th centuries AD suggests mortise-and-tenon joints were usually unpegged. While the 6th-century AD Anse St Gervais 2 vessel had a few pegged and mostly unpegged small joints, the 7th-century AD Pantano Longarini and Yassıada vessels had small, unpegged tenons that did not fill their mortises (Throckmorton and Throckmorton, 1973; Bass and van Doorninck, 1982; Steffy, 1982; Jézégou, 1983). However, the fragmentary planking-timbers from the Dor D site provide some additional evidence for the relatively poorly-represented period of the mid-5th to mid-6th century AD. The Dor D evidence indicates unpegged mortise-and-tenon joints between strakes were well-established by this time in the eastern Mediterranean. This use of mortise-and-tenon joints is largely consistent when placed into the context of these other wreck-sites, but particularly those from the eastern Mediterranean.

Likewise, the relationship between the mortises and their tenons in the Dor D timbers fits well with the corpus of evidence from the Mediterranean demonstrating that tenons drastically, and relatively

more rapidly, decreased in size than did their corresponding mortises in the 4th century AD. Subsequently, more proportional reductions in their respective dimensions took place through the 7th century (Royal, 2002). Given the possible earlier date range for operation, the planking thickness of 30 mm for the majority of the timbers found in the Dor D area also coincides with a pattern of thickness reduction exhibited by the corpus of other excavated Mediterranean vessels from the 2nd to 7th centuries AD (Royal, 2002). Additionally, what was initially thought to be a relatively late use of treenails for frame-plank attachments in the eastern Mediterranean is somewhat redressed by the suggested earlier operational date range for the Dor D vessel (Kahanov and Royal, 2001).

Conclusions

The material found at the Dor D site is problematic in nature and difficult to utilize for study. Generally, *in-situ* ceramic deposits found in Tantura lagoon are not secure, therefore a careful approach in relating ceramic deposits to shipwreck timbers is required (see for example Dor 2001/1 (Mor, 2002), and Wachsmann and Kahanov, 1997). Fundamentally, the Dor D area may be considered as a collection of fragmentary timbers, stone anchors, pottery sherds, and stone deposited from various periods swept into a collection-area. This collection-area underwent repeated episodes of burial, exposure, and mixture with sand and stone during the frequent winter storms that have scoured the harbour over the past 1500 years. Based on the authors' experience in excavating and surveying actual shipwreck sites throughout the Mediterranean, these timbers are probably remnants of a vessel that had broken free and shifted, perhaps numerous times, into their position at the Dor D site. These timbers may have been ripped from the hull of a fishing vessel, a small lighter, or a small coastal trader engaged in cabotage. At the same time these could have been the poorly-preserved remains of a stone-carrier where ceramic sherds shifting with the currents were trapped over the years. There is simply no way to determine this from the available evidence.

The fragmentary planking timbers have some limited use in illustrating aspects of ship-construction during the mid-5th to mid-6th centuries. The implications of the new dating evidence for the material in the Dor D area, as well as the elucidation of the methodology employed in its collection and analysis, underscore the limits and applications of the data. Construction details cannot be used in isolation in order to date timber finds. The understanding of ship-construction in the ancient world is far from adequate to allow such extra-polations. As evidence mounts, it is clear that, although some general trends are observable, there was also much regional variation over time; thus, there is not a simplistic, linear progression of ship construction.

Notes

1. During the winter of 2002, 10-m waves were monitored entering the lagoon, and in subsequent years waves of up to 8 m were recorded.
2. The tile fragments, also found during the 1995 excavation of the Tantura A wreck-site, were from a modern vessel with a tile cargo from Marseilles that sank in the bay, although it is not known exactly where.
3. Note the large ceramic fragment lying beneath the planking timber in the 1995 survey (Kingsley and Raveh, 1996: pl. 67).
4. Although there are not adequate timber remains to proffer a size for the original Dor D vessel, its presence in the bay necessitates it having been small and of shallow draft. The lack of spatial and depth controls noted above in the discussion of ceramic deposits also compounds their assessment.
5. For example, '*in situ*' rope within the Dor 2002/2 site was C14 dated about 600 years earlier than the wreck.

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