The landscape of the naval battle at the Egadi Islands (241 B.C.)

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The final battle of the First Punic War between Rome and Carthage, the battle of the Egadi Islands, took place in 241 B.C. Finds of multiple bronze warship rams, helmets, and amphoras, destined for a Carthaginian garrison on Sicily, confirm the naval battle's general location and define its landscape.[1] The finds suggest new lines of inquiry into the battle's precise location, the resulting landscape of battle débris, the dimensions of rams and warships in the 3rd c. B.C., and hypotheses for fleet construction and composition during the First Punic War. Subsequent publications will provide more detailed discussions of ram manufacture and their morphology, as well as the inscriptions present on the rams.

Contesto storico

La prima guerra punica ebbe la durata di un'intera generazione. Individuarne precise responsabilità rientra nella casistica tucididea dei προφάσεις (pretesti). Fu certamente uno scontro epocale tra civiltà che scoppia, ancorché non pianificato, nel momento in cui il confronto sempre più ravvicinato tra i due imperialismi diventa inevitabile. Roma vinse grazie al forte senso dello Stato della *nobilitas* romana strenuamente esaltata da Polibio.[2] Tra le fonti Polibio rappresenta la migliore; le altre fonti sono incomplete e prolisse. E' Polibio che correttamente individua nell'"ambizione per il dominio universale" (1.52.4: φιλοτιμία τῶν ὅλων) della classe dirigente romana la forza principale che fece loro vincere la guerra. I presupposti dello scontro finale possono iniziare dalla fulminea e fortunata azione di Giunio Pullo che riuscì a occupare la sommità del monte Erice e le pendici del monte dalla parte di Trapani (1.55.10: τὴν ἀπὸ Δρεπάνων πρόσβασιν). Tale azione fu determinante per gli sviluppi successivi della guerra poiché tagliavano fuori il porto naturale di Trapani dalla portata dei Cartaginesi. Frattanto c'è da ricordare che l'eparchia punica in Sicilia non esisteva più e, pertanto, quando nel 247 Amilcare Barca sbarcò in Sicilia, non aveva posizioni da tenere lanciandosi con grande astuzia in una guerra di posizione efficacemente (1.57.1-2), notevolmente onerosa e senza risultati concreti per entrambe i contendenti.

Ma vi fu un altro fattore decisivo per la vittoria romana, dovuto all'allestimento di una flotta costruita su iniziativa pubblica, finanziata delle famiglie romane più facoltose, nel 243/242, composta da 200 quinquiremi su modello di una imbarcazione punica catturata dai Romani ad Annibale Rodio nel tentativo di forzare il blocco romano stretto attorno a Lilibeo. La novità di questo tipo d'imbarcazione risiedeva nel nuovo sistema di voga con 5 rematori su ogni remo, che garantiva una maggiore velocità. Ciò fu possibile, secondo L. Basch, con la realizzazione di balconate lungo le murate dell'imbarcazione, che consentivano una maggior larghezza fuori acqua, e il restringimento della chiglia dando maggiore efficacia alle linee d'acqua dello scafo.[3] E' per questo che alla fine del conflitto si arrivò ad una spiccata standardizzazione dell'architettura navale dimostrata anche dalla identità

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1 The project was conceived and is directed through the cooperative efforts of the present authors and their institutions, the Soprintendenza Del Mare, Regione Siciliana, and RPM Nautical Foundation.

2 De Sanctis 1916.

3 Basch 1987, 353-54.

dei rostri rinvenuti che si attribuiscono ai Romani o ai Cartaginesi soltanto per l'iscrizione sulla guaina.

La battaglia vera e propria, combattuta il 10 marzo del 241 a.C.,[4] fu vinta per un concorso di fattori positivi per i Romani. Innanzitutto non lasciarono ai Cartaginesi il controllo delle isole di Favignana e Levanzo poiché da li avrebbero forzato con successo il blocco dei porti di Lilibeo e Drepanum, com'era avvenuto in precedenza (fig. 1).[5] Fu per questo che Annone, l'ammiraglio cartaginese, provenendo da Cartagine, con la sua flotta di circa 700 navi in aiuto di Amilcare accampato sulle balze settentrionali del monte Erice, si fermò in attesa a Marettimo. Da qui fu costretto a scegliere la rotta più settentrionale possibile per due ragioni: la prima perché doveva raggiungere la baia di Bonagia a Nord del porto di Drepanum poiché da questo l'ascesa all'accampamento di Amilcare era sbarrata dalle truppe romane (Polyb. 1.55.7-9; 1.58.2-3).[6] Fu qui che Annone commise l'errore fatale di non intuire che i Romani si fossero nascosti a levante dell'imponente mole della punta settentrionale di Levanzo. Non sappiamo se ciò fu l'effetto di un'abile diversione informativa operata dall'*intelligence* romana o la repentina intuizione di Lutazio Catulo, l'ammiraglio romano, che, intuendo la rotta di Annone, spostò repentinamente la flotta a Levanzo (1.60.4). A questo punto fu determinante la quinquereme poiché, grazie alla sua velocità, i Romani furono in grado di piombare in tempi rapidissimi sul fianco della flotta cartaginese impedendo l'organizzazione di un'adeguata ed efficace difesa poiché in preda ad una notevole confusione che non permise l'operatività di una normale catena di comando.

Certamente dovette giocare anche molto l'atteggiamento che i Romani ebbero verso questo conflitto. A differenza dei Cartaginesi, combattevano con l'ardore di chi vedeva nell'esito del conflitto una questione di vitale importanza. Vi era un'adesione sentita e partecipata alla guerra. Di tale differenza di attitudine al conflitto ne sono testimonianza le iscrizioni sui rostri. Quelle romane rappresentano punzoni che garantiscono la correttezza della fusione e la partecipazione finanziaria alla loro manifattura; quella cartaginese è un appello agli dei. Annone, per evitare il disastro, non poté che ordinare la ritirata favorita dal vento che gli permise una veloce navigazione con vento in poppa. Svaniva così per sempre ogni speranza cartaginese di continuare a dominare il Mediterraneo che, di li a poco, sarebbe diventato per secoli *mare nostrum*. Ma lasciamo a Polibio (1.59.1-8) il compito di spiegarci con la sua consueta lucidità il 'segreto' della vittoria romana:

> Allo stesso modo i Romani, combattendo disperatamente, benché avessero completamente rinunciato, ormai da quasi cinque anni, alle operazioni sul mare a causa dei rovesci subìti e per il fatto che si erano convinti di decidere la guerra con le sole forze di terra, ora, vedendo che l'impresa non riusciva secondo i loro calcoli, e soprattutto per l'audacia del comandante cartaginese, decisero per la terza volta di riporre le loro speranze nelle forze navali, ritenendo che solo così, grazie a questa decisione, se avessero posto mano all'impresa nel modo opportuno, avrebbero potuto dare alla guerra una conclusione positiva. E questo, alla fine, fecero … L'impresa fu, essenzialmente, una lotta per la vita. Nell'erario, infatti, non c'erano più risorse per sostenere quanto si erano proposti: tuttavia, grazie alla generosità verso lo stato e alla nobiltà d'animo dei primi cittadini, si trovò ancora quanto serviva per la sua

4 La data è riferita da Eutropio (2.27.2), e riportata da Polibio (1.60-61), che indica la fine della prima guerra punica sei giorni prima delle idi di marzo dell'anno 511 dalla fondazione dell'Urbe. Tale data è unanimemente accettata dagli studiosi anche se ha un forte carattere convenzionale e solleva qualche problema connesso sia alla data in sè, sia alla rispondenza tra i calendari.

5 Gulletta 2005.

6 Filippi 2005. Archaeological surveys carried out on the W slope of Mt. Eryx identified a wide area with Punic pottery of the same period at San Cusumano near Bonagia Bay.

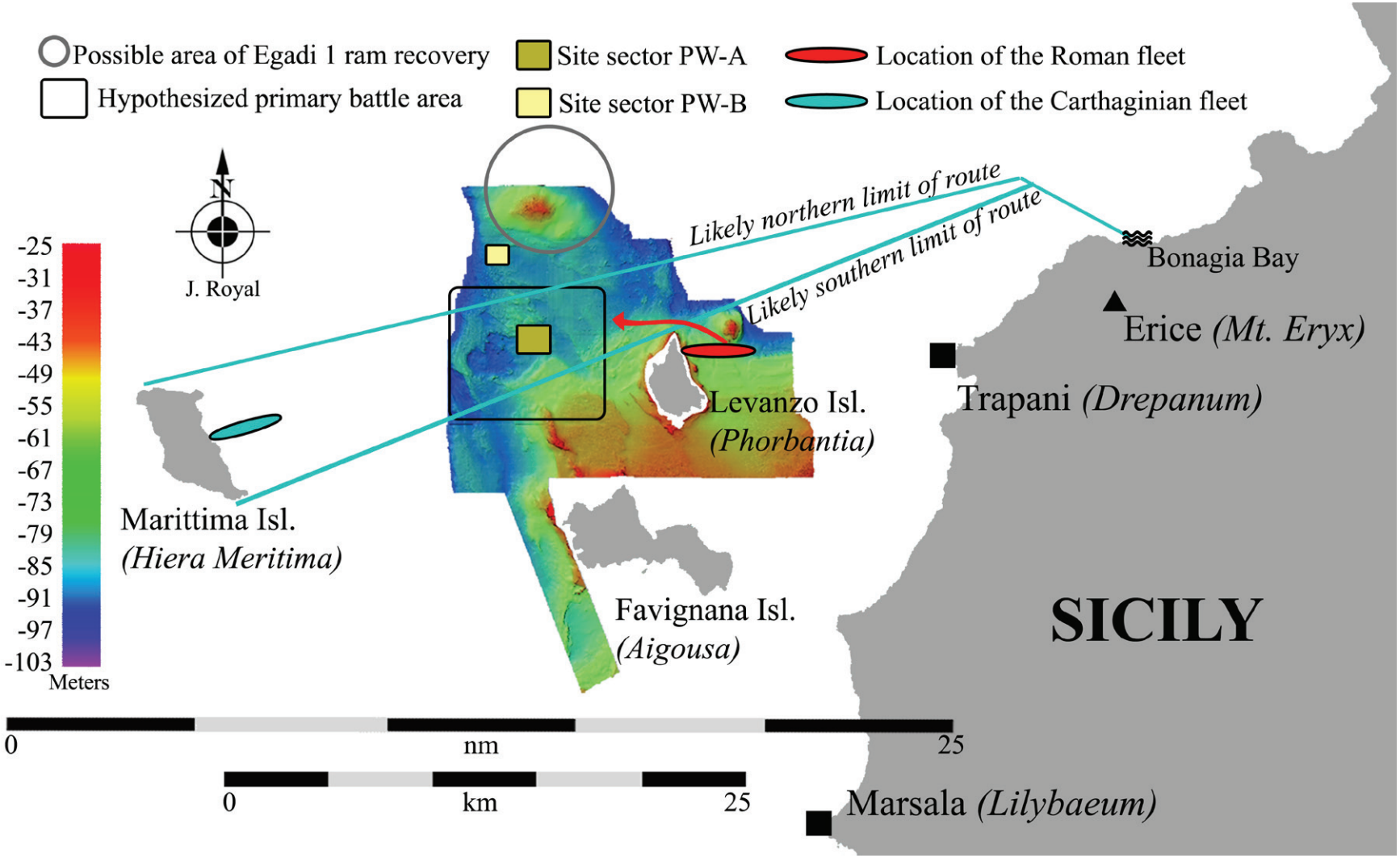

Fig. 1. Map of battle landscape with survey area through 2011, site sectors, and hypothesized movements of fleets during the Battle of the Egadi Islands (J. Royal).

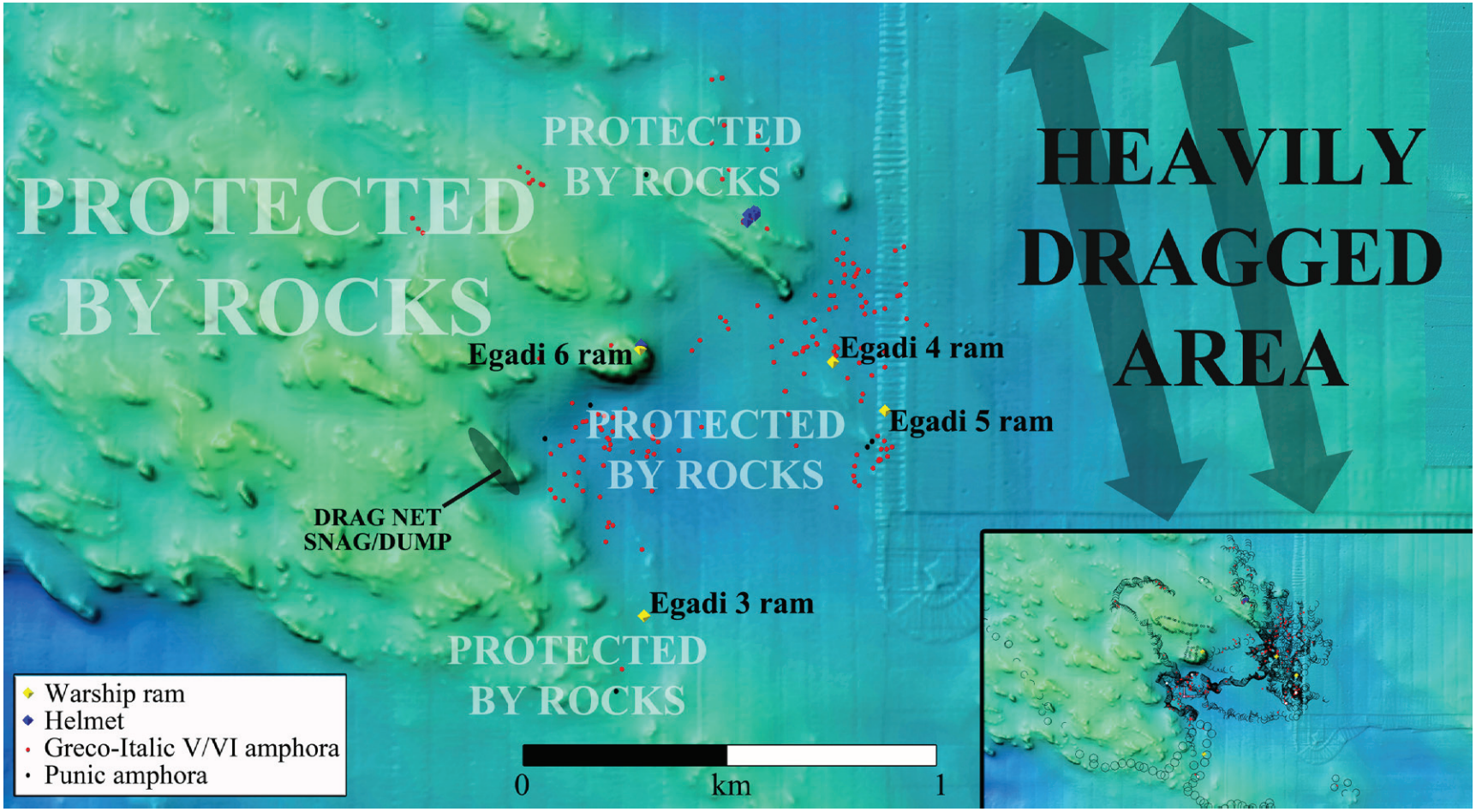

Fig. 2. Map of site sector PW-A; inset – coverage area through 2011 (Bathymetric map by Highland GeoSolutions, composite image by J. Royal).

realizzazione. A seconda della prosperità dei loro patrimoni, infatti, uno per uno, due a due o tre a tre si impegnavano a fornire una quinquiremi equipaggiata, a condizione che avrebbero recuperato la spesa, una volta che le operazioni fossero riuscite secondo i calcoli. In tal modo, essendo state rapidamente approntate 200 navi a 5 ordini di remi, la cui costruzione condussero sul modello della nave del Rodio, in seguito, eletto comandante Gaio Lutazio, lo fecero partire all'inizio dell'estate.

Overview of the project, the battle zone and landscape

Investigation into the battle zone was prompted by the Carabinieri's seizure of a bronze ram (Egadi 1) in 2004 from a private collection in Trapani. It was reportedly collected by a fisherman while drag-net fishing in proximity to Levanzo Island. Subsequently, S. Tusa attempted to localize the battle zone by examining historical sources and making an analysis of the environmental conditions of the area.[7] Punic finds at Bonagia Bay and numerous anchors discovered off the NE coast of Levanzo Island provided further clues.[8] The present authors teamed up in 2005 and established the survey project, which had amongst its goals to locate other remains from the battle zone. Assuming that the Carthaginian fleet's destination was Bonagia Bay, on the coast north of Mt. Eryx, the range of likely routes from their anchorage at Marettimo Island would pass just north of Levanzo Island (fig. 1). Allowing for the Roman fleet to round the northern tip of Levanzo Island and get into formation, we postulated that a clash of warships occurred northwest or west of Levanzo Island. In order to increase the likelihood of finding material associated with the battle (as well as sites of other eras), our survey area enveloped Levanzo Island and extended to the W side of Favignana Island. The principal methods utilized in this ongoing project are multibeam echosounder mapping combined with verification of anomalies using a Remotely Operated Vehicle (ROV). Our primary base of operations was the research vessel *Hercules*.[9] The project has completed 7 seasons of fieldwork and mapped over 270 km^2 of sea-floor. By the end of the 2011 season the location of at least one deposition area from the battle was confirmed.

The battle landscape incorporates varied sites associated with the event in its widest context (fig. 1). For the Battle of the Egadi Islands the relevant area extends from Marettimo Island where the Carthaginians anchored, through the Egadi Islands, the anchorage site off Levanzo Island, along the W coast from Marsala (Lilybaeum) from where the Roman fleet operated, to Bonagia Bay and Erice (Mt. Eryx). Historical records assist in defining the battle landscape, but it is through the archaeological investigation of cultural material and its spatial relationships that the locations of specific sites and zones are determined. Since sea battles were spread out over wide areas, our survey hopes to define multiple areas where warships clashed ('battle zones'), given that some vessels reportedly sank and others lost material overboard. Fieldwork (2005-7) defined much of the sea-floor; it indicated that dragnet fishing had impacted the area, including the battle zone we have identified. The sea-floor in the area directly west-northwest of Levanzo Island is rife with long furrows from dragnet equipment; not only are artifacts scarce, but little macrofauna remains. Concentrations of artifacts were found in areas of rock outcrops (e.g., west and north of Levanzo Island) where nets cannot enter or are caught and ripped. In 2006, the Levanzo 1

7 Tusa 2005a, 63-68; Ricordi 2005, 95-105.
8 Filippi 2005; Tusa 2005a.
9 For a more detailed discussion of the methods and equipment used during this project, see Royal and Tusa 2012.

wreck was discovered north of Levanzo Island, its survival due to surrounding outcrops.[10] Concluding that the rocky zones might be unaffected by dragnet operations, from 2008 we concentrated our search on such zones and located our first finds associated with the battle, namely the Egadi 2 ram and several Greco-Italic amphora fragments. In 2009, we continued the search in the region where the Egadi 2 ram was found, working south with few results.

In 2010, verification by the ROV revealed a concentration of cultural material with spatial and chronological associations that clearly marks at least one battle zone. The finds include 4 bronze warship rams (Egadi 3-6), at least 8 bronze helmets, and over 175 Greco-Italic V/VI and Punic amphoras all dispersed within 1 km^2 (not yet fully examined). This sector (designated PW [Punic War] -A [as the first of several sites in the area]) lies nearly 7 km west of Levanzo Island and over 6 km south-southeast of where the Egadi 2 ram, and possibly Egadi 7, were found; this latter region was designated PW-B (fig. 1), at the edge of the rocky zone. PW-A extends from the edge of an open, sandy sector (where dragging scars are prevalent) into a rocky area farther west. Although dragnets have removed almost everything to the east, we suspect that more artifacts will be found in the area continuing farther west (fig. 2). Discarded dragnets found near the rocks and a lack of drag scars on the seafloor indicate that dragging was hazardous there and was discontinued.

The artifacts in sector PW-A are thus either where they were originally deposited or only slightly disturbed. The artifact distribution (fig. 2, inset) is a product of the area searched to date. Material from east of sector PW-A or from between the two sectors had been collected in dragnets and deposited *c.*6 km north in sector PW-B when the nets struck rocky outcrops. Hence, we believe that sector PW-B represents secondary deposition of material from the battle zone, which is indicated by the débris in sector PW-A.

The rams

General features of warship rams[11] (fig. 3)

Prior to our survey, warship rams were an extremely rare artifact, with only three waterline rams known, only one of them recovered from an archaeological context.[12] To date, the project has added 7 new examples. To understand both the relationship between the rams and their warships' hulls as offensive and defensive weapons, and the relationship of ram dimensions to warship size, we must first say something about their design and manufacture. The terminology used follows that laid out by J. Steffy for the Athlit ram,[13] supplemented by additional terms proposed here (fig. 3). Warship rams were constructed by the lost-wax method whereby they were molded directly onto the bow timbers of the finished warship.[14] Hence the shape of each ram's interior is governed by the junction

10 Ibid. 31.

11 Individual ram measurements are provided in Table 1. Those for the Egadi 2-6 rams were taken by J. Royal and for the Egadi 7 ram by S. Zangara and J. Royal; those for Egadi 1 were less comprehensive and required later emendments by J. Royal. As marine growth covers the rams, they will be re-measured and weighed following conservation.

12 The Athlit ram was recovered from an archaeological context off the coast of Israel. The Bremerhaven and Piraeus rams lack provenience. A fourth ram, the Acqualadroni, was recovered in 2008 off NE Sicily.

13 Steffy 1991, 12, fig. 2-7; 18, fig. 2-13.

14 Steffy 1991, 38-39; Oron 2001.

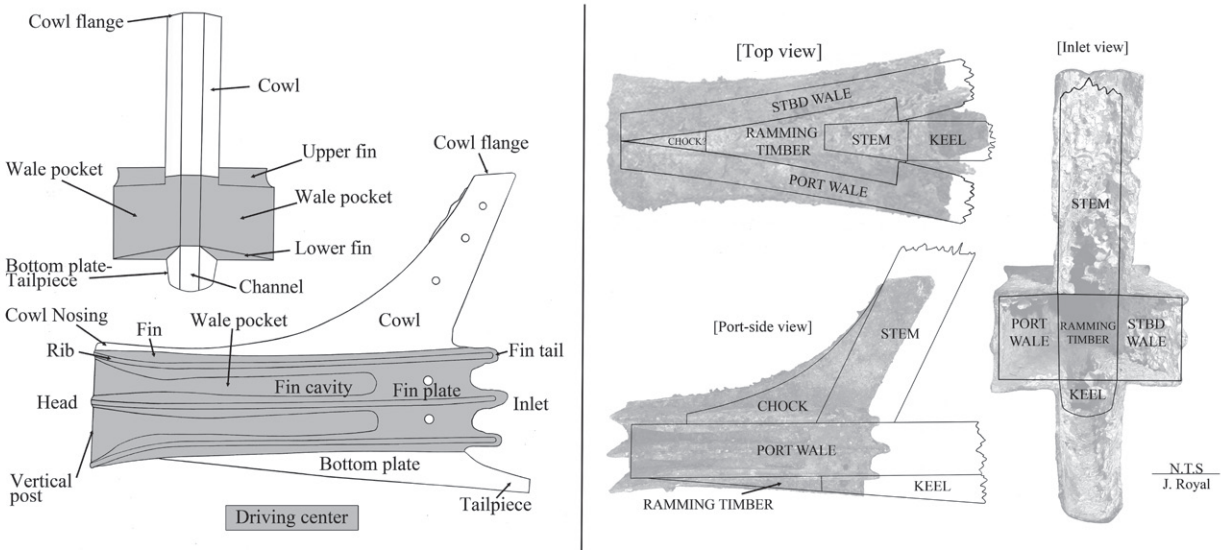

Fig 3. Warship ram terminology and hypothesized timber placements within the Egadi rams (J. Royal).

of the bow timbers. Thus interior shapes and the overall dimensions of each ram varied according to the dimensions at the bow of the ship in question. The timber configuration at each bow was designed to create a strong hull for withstanding the force of the sea, redistributing the force of impacts throughout the hull and providing a single point of impact for ramming attacks. Such waterline rams were designed for shaping the forces generated from the ramming blow, both those delivered and those incurred, and for protecting the bow timbers during impacts. As a result, each bronze waterline ram shares basic attributes with the others; these include components, morphology, and attachment strategies.

Each ram has a basic design consisting of a driving center, a cowl, and a bottom plate. The driving center, which encases the ramming timber and wale timbers, initially transfers the forces during a ramming event. It is comprised of 3 horizontal fins and the port and starboard wale pockets. It extends from the forwardmost end of the fins at the head to the aftmost extension of the inlet and fin tails. From the inlet, the wale pockets recede from the outer extent of the fins to form the fin cavities, converging at the head to form the vertical post that runs perpendicular to the center of the fins. Wale pockets have trapezoidal cross-sectional shapes as they were formed over and encased the termini of the port and starboard wales as well as the ramming timber; as such, the wale pockets serve to protect these timbers and their scarfs. The forwardmost portion of the wale pockets that abut the ramming timber join to form a solid metal mass. Each fin increases to its maximum thickness roughly one-quarter of the driving center's length measured from the head. While the upper and lower fins thicken more on their inner faces, the middle fin thickens on both faces, producing a lancelet shape. At their termination at the head, the upper fin curves upwards, the lower fin downwards, while the central fin largely remains horizontal. From their thickened and flared ends at the head, the fins converge on the sides of the driving center at the inlet to form the fin plates. Fin widths at the head follow a pattern whereby the upper fin is slightly wider than the middle fin, which in turn is slightly wider than the lower fin; this results in a trapezoid-shaped forward end. Viewed from above in plan, the fins have a constricted waist that forms the narrowest, and often shortest, part of the driving center. Ribs of *c*.0-3 – 1.0 cm^3 run centrally along the port- and starboard-side faces of each fin, from the head to just before the termini of the fin tails. Fin tails are shaped as narrow projections with rounded ends on all the rams, except for the middle fins of Egadi

6 and 7. All the rams are hollow, except for *c.*5-10 cm of solid metal at the head where the wale pockets converge and the cowl nosing and bottom plate constrict and align with the vertical post.

The cowl nosing is the forward cowl face that covers an internal chock timber; this timber sits forward of the scarf that joins the stem and ramming timber. From the upper fin, the cowl sweeps upwards from the head in an increasingly steep curve. Both sides of the cowl extend aft to a point even with the inlet. Since a ram was modelled over a warship's stem and chock that had a trapezoidal cross-sectional shape, the cowl has a narrowed forward face (cowl nosing) that widens at its aft opening. The ram's cowl sheathed and protected the warship's stem and chock, as well as the important points where timbers joined one another. One of the most critical joins was that of the stem and the ramming timber/deadwood, formed by an intricate scarf and attachments. From the head, the bottom plate extends at an angle towards the inlet; in some instances it extends beyond the after-end of the inlet to form a tailpiece. This angle typically is not perfectly linear but forms a subtle concave curvature as it was molded to encase and protect the keel and ramming timber, as well as the essential scarf that joined them.

The rams were attached to their warships with bronze spikes. In every case, except for Egadi 1 and 7, the attachment patterns on the rams' driving centers, cowls, and bottom plates are similar. Two bronze spikes were used on each side of the driving center on the fin plate, near the inlet, and in line with the two fin cavities, to secure the ram to the wales. Three bronze spikes were normally used on each side of the cowl towards its aft edge to attach it to the stem, but Egadi 1 and 7 used two per side.[15] The attachment of the bottom plate typically included at least one spike centrally located, near the plate's aft terminus. Although the rams are not fully cleaned, where discernible additional attachments exist in most cases on the starboard and/or port sides of the rams' bottom plates.

Egadi 1 warship ram (fig. 4)

A previous publication of the Egadi 1 ram provides some of the dimensions utilized here.[16] This ram has no provenience other than reportedly being recovered by a fisherman from the sea north of Levanzo Island; even if this is accurate, the precise place where the ram was picked up by the net, as well as the course of the vessel before the ram was removed from the net, remain unknown.[17] The ram is intact with no major damage or deformation. The only discernible damage are a small section aft of the upper, starboard cowl attachment, a small section aft of the lower port cowl attachment, and a small indention on the starboard side of the upper fin at the head. No construction marks were noted on the interior or exterior surfaces. Egadi 1 has the shortest driving center of the Egadi rams, being nearly identical in length to Egadi 5, yet has the longest tailpiece and the highest mid-length height and width. The reduction from the head to constricted waist is slightly greater than from the inlet. Given the ram's significant increase in height from its constricted waist, it possesses the third tallest and second widest head. Its large head combined with a short driving center gives this ram a stubbier design than the others.

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15 Further cleaning of the Egadi 7 ram revealed an additional attachment on the cowl nosing.

16 Tusa 2005a, 2005b and 2010; Buccellato and Tusa 2007. However, Royal was able to supplement these in 2012.

17 Without knowledge of its provenience, method of attachment (lost prior to its seizure), initial state of marine growth or associated finds, little can be deduced about the ram's deposition. Thus it is not conclusive that this ram is associated with the events of the battle of 241.

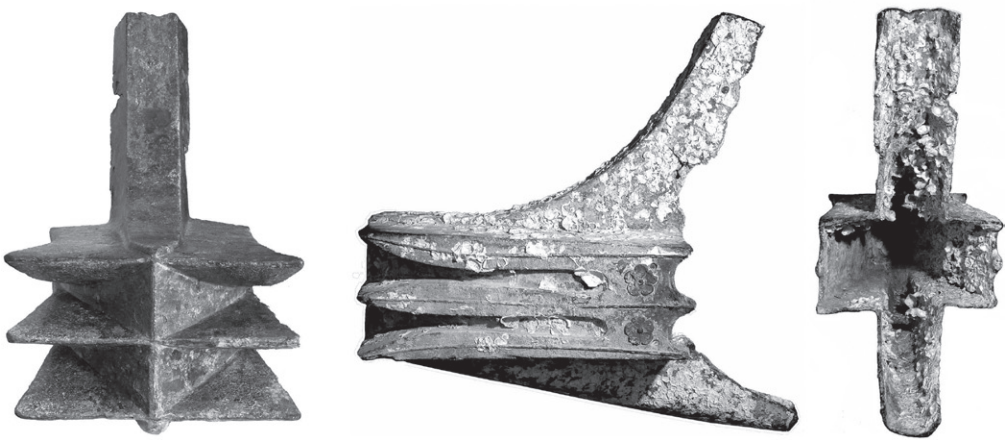

Fig 4. The Egadi 1 ram (S. Tusa).

In addition to the 4 cowl attachments, there was a single attachment through the cowl nosing driven into the chock. There are no attachments on the bottom plate to affix the ram directly to the keel. The arrangement of the locations of spikes and the presence of decorative features on the fin plate are also unique. Two distinctive 'rosette' elements formed by a central rounded knob surrounded by 5 petals are located on the fin plates of each side; they are set in line with the fin cavities so that the spike attachments are displaced to just above and aft for the upper spike, and just below and aft for the lower spike attachments. A Latin stamp was discovered on the lower cowl nosing (see below).

Egadi 2 (Catherine D[18]*) warship ram* (fig. 5)

The Egadi 2 ram was discovered in 2008 within sector PW-B *c.*10 km northwest of Levanzo Island. A thorough search of the sea-floor in a 50-m radius yielded no other artifacts. A number of broken Greco-Italic type V/VI amphoras were found amongst rock outcrops within 500 m to the north-northeast. The ram lay inverted on a flat seabed, roughly one-third buried in soft sand. Excavation around the ram to a depth of *c.*15 cm to ascertain its structural integrity revealed no artifacts. The surrounding matrix consisted of sand, small shells and stones, with a substrate of hard-packed sand below. This was not its

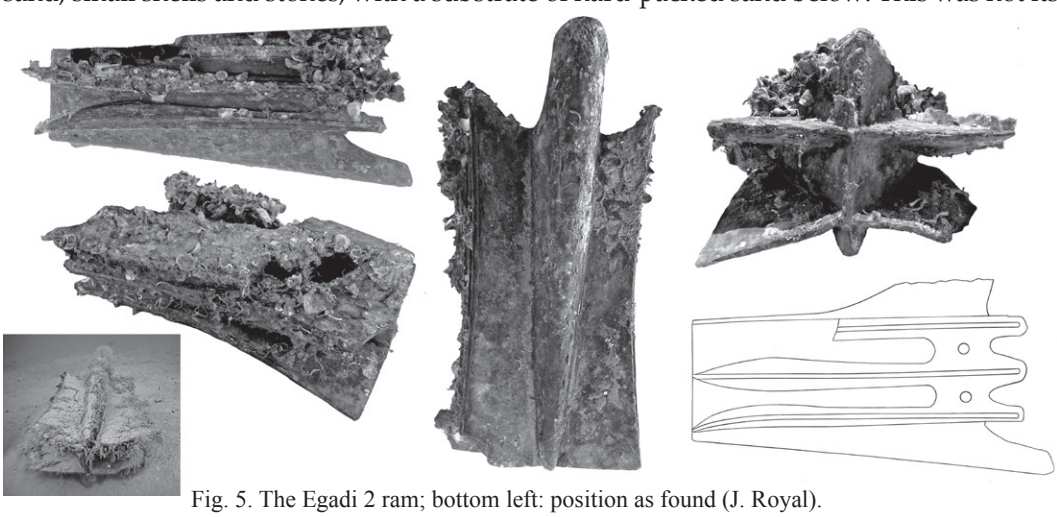

Fig. 5. The Egadi 2 ram; bottom left: position as found (J. Royal).

18 Each ram recovered during our survey or delivered to authorities after collected from the Egadi Islands is designated with a running numerical designation (Egadi #). Those rams discovered during our own survey operations receive an additional designation of a name.

original place of deposition, to judge from the minimal amount of marine growth on the exposed bottom plate and lower fin (i.e., its upper surfaces when discovered). Its original location had lasted much longer, as indicated by the greater amount of marine growth on its upper half. Some 40% of the upper fin in the aft portion and most of the cowl were missing; none of the breaks were fresh and marine growth covered portions of them. As discovered, the ram's upper half was almost entirely buried in sand, which had killed the marine growth that had originally formed there. Since most of the damage was on this upper half and since the breaks were covered with growth, several conclusions are possible: a) the ram had sat in an upright position upon its initial deposition; b) the damage to the upper half could not have occurred when it was repositioned upside down in the spot where we discovered it; and c) this damage must have occurred prior to the ram's original deposition, the most likely cause being a violent collision with another warship during the battle. This conclusion is supported by the wood remains trapped between the starboard side of the lower and middle fins at the head, a result of ramming an enemy hull.

Because the ram is split, the cowl nosing from the head extends *c.*16.0 cm aft, where it joins with the surviving section of the cowl. The cowl nosing widens from 0.5 cm at the head to 5.5 cm at a point *c.*7.0 cm aft. A gentle upward angle is preserved in the surviving portion of the cowl, along with a small preserved portion of the join between the starboard side of the cowl and the upper fin. This indicates it was probably of the same general shape as the other rams. The forward corners on the starboard side of the middle fin and port side of the lower fin are missing, but the ram's bottom plate and short tailpiece are undamaged. The ram's fin tails are longer and come to a narrower rounded point than on other Egadi rams. Groove-and-ridge patterns are found on the interior of the wale pockets, a product of shaping the wax model on the ship's bow timbers. This ram has the third smallest driving center and its head's height and width dimensions are the smallest of the rams found thus far. The head has only a moderate amount of flare. Since the inlet is wider than the head, it has an asymmetrical shape in plan.

As the ram is incomplete, it is impossible to determine the locations of all spike attachments that affixed it to its warship's bow timbers. Two spike connections survive on the port and starboard fin plates. An additional bronze spike (1.07 cm diam.) was driven through the starboard side of the bottom plate at *c.*2.0 cm from the join with the bottom fin; none was located on the port side. One of the surviving spikes, located between the lower-middle fins on the starboard fin plate, extends more than 6 cm into the ram's interior with no deformation or bending, and specifically none towards the inlet end. There is no indication of deformation on the ram's driving center or bottom plate that would indicate that the warship's timbers and ram had been pulled apart forcefully; thus the ram must still have been attached to the wale timbers when it was deposited. Initially deposited in an upright position, only exposure to teredo can account for the absence of timbers as well as the lack of deformity to the attachments left in place. Here too a heavy layer of marine growth formed on the upper half of the ram (including the damaged edges of the missing upper fin and cowl section). After being dragged from its original place of deposit (possibly from the E edge of our sector PW-A) within recent decades, the ram was deposited in an inverted position with its damaged and growth-covered upper half now buried. In its new location the marine growth on the now-upright bottom plate has been minimal.

Egadi 3 (Vincenzo T) warship ram (fig. 6)

The ram was found in 2010 in sector PW-A lying on its port side at a depth of 81 m. No intrusion into the shallow sediment was noted and no other surface deposits of artefacts

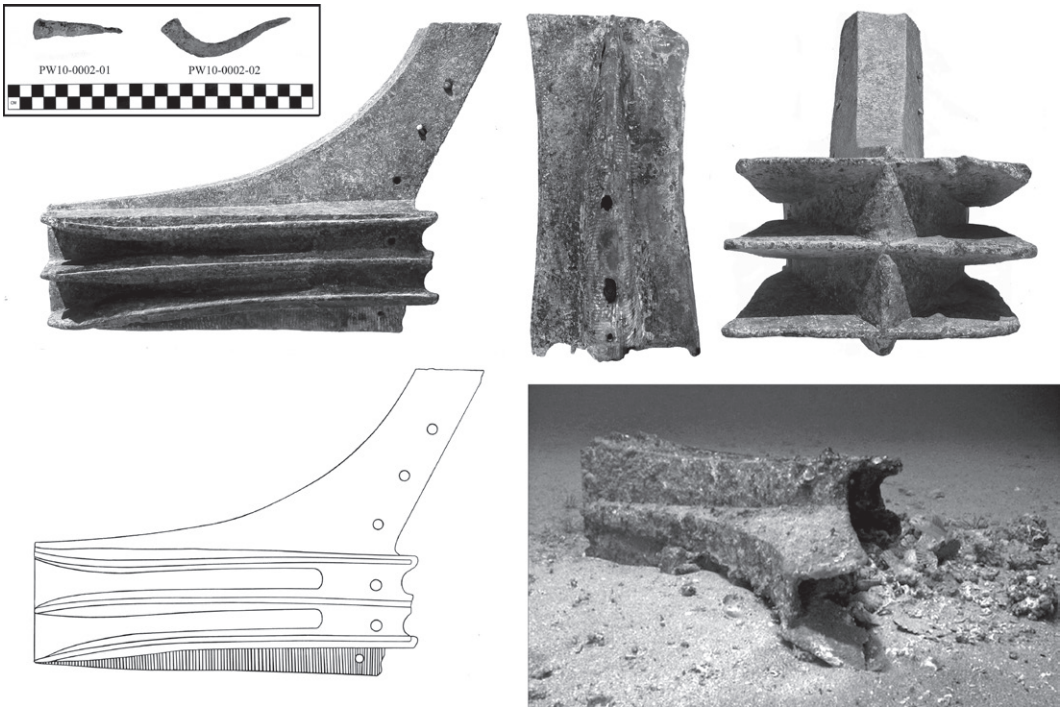

Fig. 6. The Egadi 3 ram; top left: nails found within ram (J. Royal); bottom right: findspot of ram (RPM).

were observed within a radius of 3-4 m. Starting at a distance of 5 m, several amphoras included Greco-Italic and Punic types. Rocks, shells and other débris, caused by octopus nesting, filled and spilled from the ram's cavity on the seafloor. There are no major missing portions or damage other than broken fin tips at the head, slight damage on the aft end of the bottom plate and fin tail, and a series of V-shaped notches across all three fins at the head midway between their port sides and the vertical post connection. The notches are vertically aligned, decrease in depth from top to bottom of the fins, and make a crumpled pattern formed by a forward impact. All of the damage is covered with identical amounts of growth present on the rest of the ram's surfaces, which indicates damage pre-deposition. In addition, the structured light scanning (SLS) and X-ray fluorescence (pXRF) examination indicates the corrosive period, or the time exposed to seawater, for all the damaged areas is equivalent to the time of exposure for the undamaged portions of the ram's exterior. Both sets of evidence are in accord and place the timing of the damage prior to deposition.[19] The nature of this damage is enigmatic, although it is clear that the ram struck a V-shaped metal object head-on. Since the V-shaped notches match the angle of the vertical post at a ram's head, one possibility is a ram-to-ram collision. In this instance the ram could have struck a ram with a greater head height, such that each fin made contact with the opposing vertical post.[20] It is also possible that the ram struck some other metal

19 Hassebrook *et al*. 2011. SLS utilized photographic images from different angles with various light patterns, while pXRF scans the surface area of the object in a three-phase scan to determine elements in three spectral ranges. Subsequent analysis provides the chemical composition of the object's surface, micro-fracture information, and produces a three-dimensional model.

20 The lack of damage on the ram's vertical post, presumably where the opposing ram's fins would have struck, may be due to the greater structural strength of vertical posts formed by thick solid metal than of the fins. Hence, the opposing ship's ram also suffered damage to its fins, but not its vertical post.

object of a similar shape, or the corner of an object with a square cross section affixed to an opposing ship.

Compared to the others, this ram has moderate dimensions which include an average length driving center, average head width and height (Table 1). It has no tailpiece, is symmetrical in plan, and shows little change in height from the head to central waist. The exterior of its bottom plate is covered with groove-and-ridge patterns running perpendicular to the plate's length along its starboard and port sides, while the marks run lengthwise on its bottom face. They were undoubtedly made when the wax mould was shaped by a tool, yet no effort was made to smooth the exterior surface of the bottom plate prior to casting. An inscription in Punic script of the 3rd c. B.C. (see below) is located on the ram's cowl nosing; it was made by incision with a sharp instrument that cut into the wax layer of the mould prior to casting. An experimental analysis[21] of the Egadi 3 ram provided an indication of its composition on its outer, corroded surface. The unusually high percentages of lead (27.0-36.3) and tin (12.7-20.2) as compared to copper (37.7-41.2) is partly explained by the leaching of copper. Analysis of bronze cores is required to determine original relative percentages, but it is already clear that a surprisingly high percentage of lead is present.

TABLE 1
SELECT RAM FEATURES, MEASUREMENTS, AND CALCULATIONS

	Egadi 1	*Egadi 2*	*Egadi 3*	*Egadi 4*	*Egadi 5*	*Egadi 6*	*Egadi 7*
			FEATURES				
Find location	Unknown	PW-B	PW-A	PW-A	PW-A	PW-A	Unknown
Cultural affiliation manufacture	Rome	?	Carthage	Rome	?	Rome	Rome
Cowl curve rise	Vertical	Vertical?	Vertical	Vertical	?	Vertical	Vertical
Cowl join location	Set back	Set back	Set back	Set back	Set back	Set back	Set back
Cowl nosing	X	X	X	X	X	X	X
Waisted flared ends	X	X	X	X	X	X	X
Lanceolate fins	X	X	X	X	X	X	X
Tail fin pattern	Points	Points	Points	Points	Points	Indent	Indent
Tail fin extension	Moderate	Short	None	Short	None	Short	None
Molded decoration	X	?	-	X	?	X	X
Inscription	Latin		Punic	Latin		Latin	Latin
Driving center attachments	4	4	4	4	4*	4	4
Cowl attachments	4 + 1	-	6	6	-	6	4
Bottom plate attachments	0	1	2	1	3	2 or 1	2 or 1
			MEASUREMENTS				
Max l.	84.0	76.5	85.0	93.5	64.0	100.9	74.0
Driving center l.	58.8	66.3	74.4	83.4	59.5	85.9	69.0
Head h.	22.2	19.9	21.5	21.8	21.5	24.0	24.0
Average head w.	40.5	31.1	37.4	35.6	32.2	40.6	38.0
Average inlet w.	39.7	38.4	37.9	35.5	31.5	44.5	39.0
Fin w., central constriction	33.3	27.7	31.6	27.2	28.5	30.6	33.6
Fin h., central constriction	21.0	17.7	20.2	18.0	17.0	20.3	20.0
Cowl vertical h.	38.8	-	36.9	35.6	-	30.0	38.0
Length along cowl face	?	-	91.2	96.0	-	94.0	88.5
Th. at inlet	1.5	1.1	0.9	0.5	0.8	0.9	0.9

21 X-ray fluorescence was chosen by the researchers as it was a non-destructive method that provided rapid elemental composition of corrosion and metallurgy for the two bronze artifacts: Hassebrook *et al.* 2011.

	Egadi 1	*Egadi 2*	*Egadi 3*	*Egadi 4*	*Egadi 5*	*Egadi 6*	*Egadi 7*
Th. of bottom plate aft	0.7	1.0	1.1	0.5	1.1	0.9	0.8
Length of tail piece	24.5	15.5	0.0	18.0	0.0	15.1	0.0
Upper fin th., mid length	5.3	3.7	4.2	3.2	3.0	3.6	3.5
Middle fin th., mid length	5.0	3.2	3.8	2.9	3.4	3.4	3.1
Lower fin th., mid length	4.5	3.5	3.6	2.9	3.3	3.7	2.9
Avg. fin th., forward bulge	5.6	4.6	4.9	4.1	4.6	4.4	4.0
Rib th. range	0.6-0.8	0.8-1.0	0.6-1.0	0.7-0.9	0.7-1.0	0.6-1.0	0.3-0.8
Rib extension range	0.6-0.8	0.8-1.1	0.7-1.2	0.8-1.0	0.8-1.0	0.6-1.0	0.4-0.8
Outer cowl w. at top, aft	15.7	-	21.1	13.0	-	17.5	16.5
Outer cowl w. at top, fore	9.5	-	11.5	8.5	-	10.6	10.0
Spike head diam. fin plate	1.1	1.7	-	1.3-16	1.4-1.8	1.3	1.3
Max. inner bottom plate	15.3 x 9.1	12.0 x 12.0	9.0 x 13.5	10.0 x 10.4	17.1 x 12.4	14.4 x 14.5	11.7 x 11.4
Max. inner wale pocket	17.3 x 14.4	17.1 x 8.0	15.0 x 10.0	15.0 x 9.0	12.7 x 9.0	17.7 x 11.5	21.1/14.7 x 11.8
			CALCULATIONS				
Est. keel molded x sided	13.3 x 11.1	16.8 x 14.0	18.6 x 15.5	14.9 x 12.4	17.3 x 14.4	19.8 x 16.5	16.1 x 13.4
Est. keel cross-section (cm^2)	147.6	235.2	288.3	184.76	249.1	326.7	215.7
Stem max. molded x sided	18.0 x 16.5	-	22.0 x 20.0	17.0 x 15.0	-	20.0 x 18.0	22.0 x 20.0
W. reduction inlet to waist	16%	27.9%	16.6%	23.4%	9.5%	31.2%	13.8%
W. reduction head to waist	17.7%	10.9%	15.5%	23.6%	11.5%	24.6%	11.6%
H. reduction head to waist	5.4%	12.1%	6.0%	17.4%	20.9%	15.4%	16.7%
Head w. to inlet w. coefficient	1.0	0.8	1.0	1.0	1.0	0.9	1.0
Striking surface ($cm^{2)}$	70.8	57.9	68.6	65.6	61.6	74.0	69.5
Striking area ($cm^{2)}$	899.1	618.9	804.1	776.1	692.3	974.4	912.0
Head aspect coefficient	0.55	0.64	0.57	0.61	0.67	0.59	0.63

H./h. = height, W./w. = width, th. = thickness, Avg. = average, Max. = maximum, Est. = estimated

The ram was affixed to the bow with attachments additional to those of a typical fastening pattern; they include a spike driven on each side of the cowl's base near the inlet edge, and an additional bronze spike driven through the starboard side of the bottom plate near the aft edge of the tailpiece. One of the spikes (0.8 cm max. diam.) through the starboard fin plate remained intact; it extends nearly 3.0 cm into the ram's interior; it is not deformed and is clearly in its original orientation. Three bronze spikes with round, tapered shafts in the cowl also remained in place, extending into its interior, although their lengths may be truncated. None of these attachments seemed to be deformed and their orientation was parallel to the stem's sided face.[22] Both iron and bronze intact attachments were found loose within the ram's interior cavity. One loose iron nail (PW10-0002-01, length 7.2 cm., diam. of head 1.7 cm; fig. 6) was straight; another (PW10-0002-02, length *c*.14 cm, diam. of head 1.2 cm; fig. 6) was bent. These iron nails were not associated with the ram attachment but were used in timber attachments inside the warship. In view of the iron nails and the undeformed attachments in its interior, it is evident that the ram was deposited while still attached to the bow timbers. The timbers were subsequently eaten away by teredo worms, leaving the attachments in place. The pXRF analysis indicates the interior of the ram has endured less corrosion time than the exterior, for the entire inner surface was filled and

22 Sided refers to the faces of ships' timbers that are parallel to the vertical plane; the sided dimension is the distance between these faces. Molded faces of timbers are those parallel to the horizontal plane; the molded dimension is the distance between them.

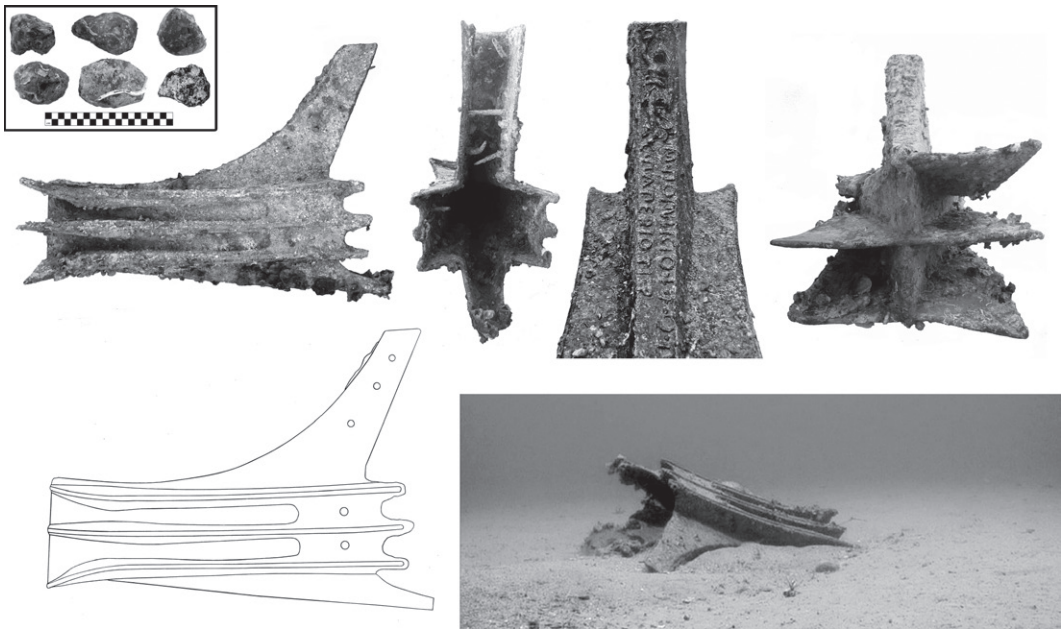

Fig. 7. The Egadi 4 ram (J. Royal); top left: possible ballast stones (J. Royal); bottom right: findspot (RPM).

blocked from the flow of water for a period after its deposition.[23] This implies that the ram remained fitted on the bow of a warship at the time of its deposition. The small stones, ceramic sherds, bronze nails and iron nail concretions dragged into the cavity by an octopus show that the ram remained near a wreck site, probably that of its own warship, after the timbers had rotted away.

Egadi 4 (Claude D) warship ram (fig. 7)

The ram was recovered in 2011 in sector PW-A at depth of 80 m and *c.*100 m south of a rocky area that extends slightly farther east. Here it was largely protected from dragnet operations running north-south. The ram was found inverted within a slight depression, with minimal burial, sitting above an intact, half-buried Greco-Italic V/VI amphora (PW11-0011). Excavation around ram and amphora to free them for recovery revealed no other cultural material other than fist-sized stones, two of which were raised for analysis; 6 additional stones were found inside the ram's cavity (fig. 7, inset). These smooth stones appear intrusive to this region and are of sizes consistent with ballast stones.[24] Also found within the cavity were 3 tile fragments, a pottery sherd, and an iron nail concretion from the hull. This cultural material was in the innermost section of the cavity, at the head; near the entrance to the cavity were primarily shells and rough fragments of rock, which again suggest that the cultural items were pulled into the ram by octopuses after the wood inside it had rotted, and that the ram remained near the site of the wreck. A small section of the keal was preserved in the forward section of the bottom plate.

The primary damage to the ram was the missing front corner portion on the starboard side of the upper fin; the corrosion and marine growth indicate that this was an old break.

23 Hassebrook *et al.* 2011.

24 Several stones are undergoing petrological analysis by M. Aulinas Juncà and G. Alias (Department of Geology, University of Barcelona).

The straight angle of the break, without associated deformation, indicates that the corner was cleaved off by a direct impact on the head. This kind of sheer break requires a great concentrated force, a force realized during a ram-to-ram collision in which only the top fin of the ram's starboard side bore the initial hit. The port side of the upper fin is deformed upwards, a possible result of contact later in the impact event; occurring later, the force would have diminished when the port fin was struck (a split due to casting imperfections is unlikely, given that rams were cast head down and weaker planes within the casting were perpendicular to the long axis).

This is the second longest ram overall and has the second-longest driving center (Table 1). In plan it has a symmetrical shape, with a significant amount of head flare (the most in its width). Rectangular chaplet ends, made flush, that were placed into the mould for casting are visible running along both fin cavities on the port and starboard sides. On the cowl nosing is a molded decoration and inscription (see below); no other decorations or construction marks appear on the visible surfaces. All the bronze attachments on the cowl and driving center were preserved to some degree; they extend into the interior of the ram. Each attachment was either straight or curved in a manner consistent with attachments being driven into wood. The center bronze spike on the starboard side of the cowl was completely straight and intact through to the opposing face of the cowl. It appears the spikes were purposefully angled, presumably with pilot holes, aftward into the stem; this would have been prudent so as not to risk splitting the stem along its thinner outer face. In order for these bronze spikes to be preserved in this manner, the ram must have been deposited on the sea-floor while attached to the bow timbers. Further evidence for the presence of the bow timbers can be seen in the remains of wood within the starboard wale pocket and bottom plate, preserved due to the leaching of copper.

Marine growth was heavier on the central portion of the driving center's starboard side than towards the head and inlet; the greatest amount was on the underside of the bottom fin and bottom plate. A moderate growth was seen on the port side of the driving center and the cowl, but the starboard side of the middle fin at the head was largely free of growth. This pattern is consistent with the ram still being attached to the warship when it came to rest on the seafloor. The length of hull aft of the ram would have been over 6-8 m in order to counterbalance the ram's weight and prevent it from tipping forward. If the ram had tipped forward while attached to its bow, the starboard side of the lower fin and bottom plate would have sunk into the sand and no growth could have accumulated, nor would the ram have fallen over in an inverted position. Once degraded by teredo, the ship's bow timbers weakened sufficiently so that the ram fell free because of its weight. It struck and rolled off the amphora below it, aided by its heavy cowl, coming to rest on its starboard side. Given the missing starboard portion of the upper fin at the head, the middle fin would have nested into the sand, bearing the ram's weight at the head. The ram remained in this position until its discovery, inverted with its inlet extending above the amphora, and only slightly buried. Here it rested on the upper portion of the starboard side of the inlet end driving center as well as the upper-starboard tip of the cowl and on the starboard side of the middle fin at the head. Marine growth adhered to the exposed portions as it slowly settled into the shallow sediment layer, but the growth was less where it rested on the sea-floor and almost completely absent on the starboard side of the middle fin at the head. Additional support for this depositional sequence is found on a stain across the forward starboard quarter of the ram that was created through proximity to an

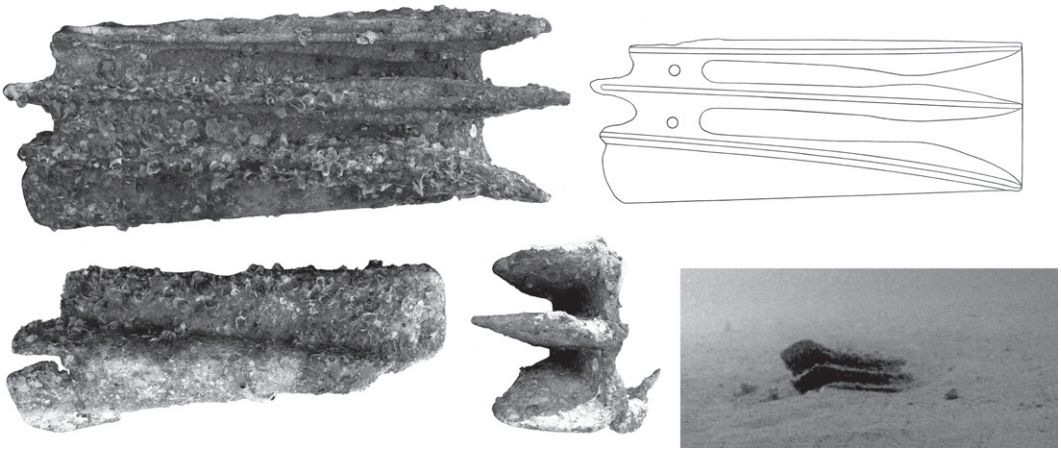

Fig. 8. The Egadi 5 ram (J. Royal); bottom right: findspot of ram (RPM).

iron object[25] that oxidized, the angle of which matches the plane of the sea-floor in relation to the ram as discovered and shows that the iron object was lying beneath the ram where its head came to rest. As iron oxidizes quickly in seawater, the ram will have come to rest on its starboard side shortly after the warship reached the sea-floor. This is consistent with the degradation of the hull timbers and the lack of marine growth on the starboard side of the middle fin at the head.

Egadi 5 (Rachael R) warship ram (fig. 8)

The Egadi 5 ram was found in 2011 on the E edge of site sector PW-A, *c.*110 m southeast of Egadi 4 at a depth of 84 m. Its findspot was slightly beyond the westward extent of the central flat sandy zone, at a point where the amphora scatter ends and dragmarks begin; here is the apparent limit of the area protected from N–S dragnet operations. The ram was found inverted with a small piece of static net beneath it. Static net operations, which took place within sector PW-A through 2011 and have the ability to move lighter artifacts small distances, could not move an intact ram, but this ram is fragmentary, having lost most of its cowl and its port side. Some 30% of its upper fin remains, along with most of the bottom plate. No decorations or writing were cast or inscribed on the surviving portion, but the groove-and-ridge pattern, similar to that found on Egadi 2 and 3, is present along the bottom plate, again from unsmoothed tool marks in the wax layer prior to casting.

Although this ram has the shortest driving center and one of the smaller head widths, its head height is on a par with that of the other Egidi rams. Its keel dimensions (as indicated by the width and height of the channel of the bottom plate) are larger than all the others except Egadi 6, which has similar dimensions. This ram has a symmetrical shape in plan, with the greatest decrease in height from head to the mid-length waist yet little reduction in width over this same length; as a result it has one of the stubbier shapes. The short driving center reflects a short ramming timber on its warship's bow, yet the keel dimensions indicate a vessel of similar dimensions as is associated with the other rams. Thus the ram was modeled over the short ramming timber that required a sufficiently wide head and increasing width at the inlet as the ram extended onto the widening hull.

25 Common iron objects aboard ships included the fastenings in the hull timbers, anchors, and tools; given that this was a warship, other possible objects include weapons and fittings of various kinds.

The short distance between head and inlet, as well as the large internal timbers, effectively limited the degree of narrowing of the ram's width at the waist. With little forward projection from the ship, there was insufficient length to expand fully the width at the ram's head; thus in order to attain a sufficient striking area at the head, the bottom fin splayed downwards at a greater angle at the head, which accounts for the relatively high reduction in fin height from the head to the mid-length waist.

Marine growth was heavy on the ram's starboard side, the bottom plate, most of the remaining top fin, and throughout its interior. Growth was observed on all of the broken edges. The pattern suggests that this portion of the ram was exposed for a long period. However, two *c.*2-cm areas on the broken edge of the top fin are devoid of growth, exhibiting a green color characteristic of bronze corrosion; here small fragments were recently separated, possibly due to the action of the static net. Both bronze spikes on the starboard fin plate have their heads (diam. 1.4 cm) in place, but only a nub of each of their interior length survives. Two spikes on the underside of the bottom plate are missing, but a portion of the one on the starboard side survives (diam. of head 1.4 cm), curving forward *c.*4.0 cm into the ram's interior, which indicates that this piece of the ram was still attached to the keel when it was deposited on the sea-floor. The ram's port side and cowl suffered great damage; a complete sheering along its longitudinal axis evidently occurred prior to deposition. To judge by the bottom plate attachment, at least part of this badly damaged ram remained fixed to the warship's bow timbers; then after degradation of the timbers separate pieces fell away. The portion recovered was evidently snagged in a static net and moved a short distance, to be deposited in an inverted position; the rest of this ram is probably still to be discovered. Given the keel attachment, it is not possible that this piece of ram fell from the warship while it was on the surface: it is not feasible that a ship's keel at

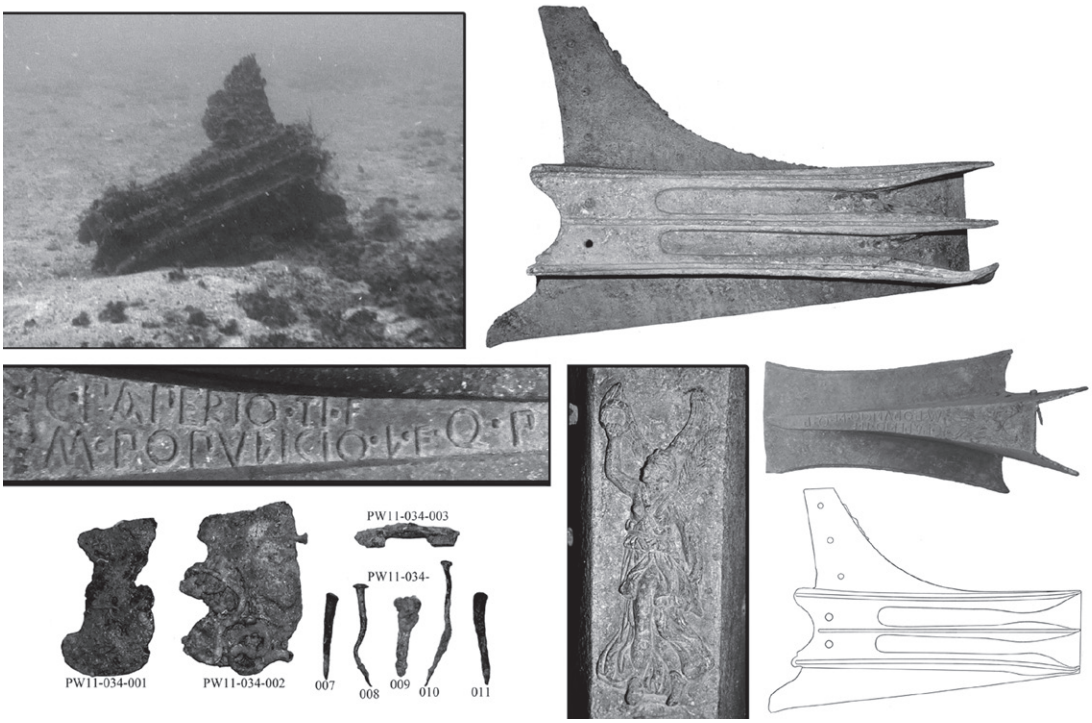

Fig 9. The Egadi 6 ram (J. Royal); bottom left: cheekpieces and nails found within ram (J. Royal); bottom center photo by S. Zangara; top left: find location of ram (RPM).

this junction with the wales at the bow, or any part of the bow, could become separated from the rest of the hull (see below).

Egadi 6 (Cece) warship ram (fig. 9)

This ram was found in 2011 at the W edge of sector PW-A at a depth of 72 m, nearly 500 m west of rams 4 and 5. Completely intact, the ram was sitting upright at the base of a large outcrop, listing to starboard. This location is inaccessible to dragnets, while its weight prevented it from being disturbed by static nets. Thus there is no indication that it has moved after deposition on the seafloor. Due to the extremely thin sand cover, heavy marine growth adhered to nearly every surface except the corner of the bottom fin on the starboard side at the head, where the fin supported the ram's weight. Nesting by octopuses brought numerous finds into the ram's cavity, all near the head: iron nails, a tile fragment, two bronze cheekpieces for Montefortino helmets (PW11-0034-001 and PW11-0034-002; fig. 9), and a bronze hinge (PW11-0034-003; fig. 9) that connected a cheekpiece to a helmet (see below). Five of the iron nails range in length from 7.4 to 12.1 cm (fig. 9, inset) with square heads (diam. 1.0-1.3 cm) and shafts that taper (from 0.5-0.6 cm diam. near the head to 0.1-0.3 cm at their tips). These nails were clearly used for timber attachments within the hull and are not associated with attachment of the ram to the hull. They suggest that the ram has remained near the original wreck site.

There was little damage to the ram other than bending of the upper and lower starboard fins at the head, almost certainly due to it having rammed into the hull of an enemy ship; wood trapped between the upper and middle fins and the middle and lower fins at the starboard side of the head attests to this. The cowl nosing bears a molded decoration and inscription (see below). All of the ram's surfaces were smoothed of manufacturing marks. A distinctive design feature is the concave profile between its upper and lower tail fins at the inlet. It has the longest driving center (it is slightly longer than Egadi 4) and the longest tailpiece of all the rams. Its wide mid-length dimension flares to the head and inlet, giving a slightly asymmetrical shape in plan. The head has a high degree of horizontal splaying that is not offset by the increase in height; as a result, it has the widest shape of the Egadi rams. The inner dimensions of the wale pockets and bottom plate channel indicate slightly larger wales and keel, respectively, than for all other rams except Egadi 5.

Four bronze attachments on the cowl and two on the fin plates extend from 3.0 to 7.2 cm into the ram's interior at varying angles consistent with their being driven into wood from the outside and not bent outward. The other two fin-plate attachments have only surviving heads, but taken together they attest to the ram being attached to the bow timbers when it reached the bottom. Further evidence for the presence of the bow timbers comes in the significant wood remains within the wale pockets and bottom plate, and the remnants of the ramming timber at the head, all preserved by the leaching of copper. With the upper fin cleaned, at least two rectangular chaplets, made flush, were noted on its upper surface towards the inlet.

Egadi 7 (Maltese) warship ram (fig. 10)

The Egadi 7 ram is without a verifiable provenience: reportedly it was pulled from the northwest of Levanzo Island by fishermen. Although there is uncertainty as to whether it was found within the battle zone, it is likely that it is associated with the event. A molded decoration and a Latin inscription extend down the upper portion of cowl's nosing (see below) and, like Egadi 6, it has a concave indention between the upper and lower tail fins at the after end of the fin plate. A series of initial measurements allow for a comparison

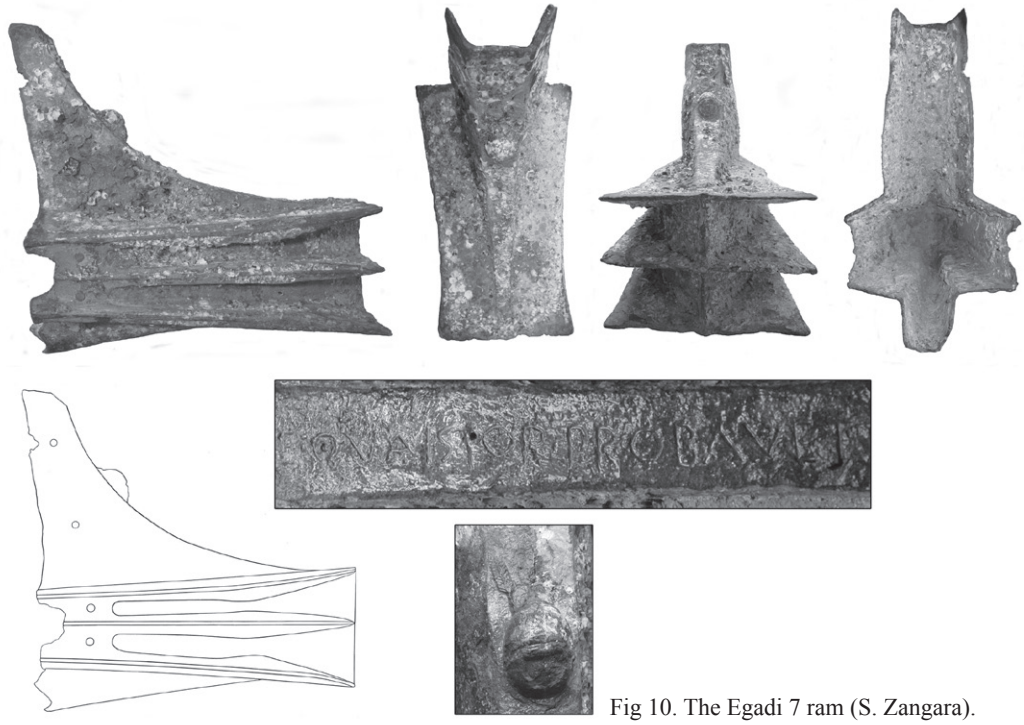

Fig 10. The Egadi 7 ram (S. Zangara).

with the other rams.[26] In general its shape, size, and features are consistent with the others: its driving center length, width of inlet, thickness of fin, and height of driving center are values in the middle range, but it has some of the larger head dimensions. Thus it is one of the stubbier rams, with a relatively short length along the cowl face. It is the widest ram at the waist, but maintains a symmetrical shape in plan. Damage is slight, with similar missing portions located just aft of the upper, starboard cowl attachment. Small notches on the upper fin at the head, particularly the port side, seem old and worn smooth. Perhaps this ram was fitted on a warship that had seen a long period of service. The most conspicuous damage is the possible complete removal of the face of the molded head, the ragged boundary and lack of any other deformation suggesting deliberate removal in antiquity.

Helmets (Table 2)

Helping to confirm sector PW-A as the battle zone are at least 8 bronze helmets, scattered mostly in a concentrated area (see below). Two cheekpieces (both for the left side, so representative of two helmets) and one hinge connection were also found within the Egadi 6 ram. Seven helmets lay in a limited area of *c.*25 m^2; the eighth was found in the rocks *c.*200 m to the southwest, within 30 m of the location of Egadi 6. All were lying on the bottom and not buried to any significant degree. A further helmet (now in the Favignana Maritime Museum) was reportedly raised from sector PW-A before 2005 by fishermen with static nets. Four helmets, all of the Montefortino type, were raised in 2011 (fig. 11, indicated by PW11 numbers); sections of the dome were missing on two (PW11-0010 and PW11-0031), while the other two were intact. Even though there is no standardization in their size, these four helmets exhibit a number of similar characteristics:

26 Measurements and photographs are by S. Zangara (Soprintendenza del Mare) and J. Royal.

manufacture from cast bronze that was then worked into a thin dome; a dome with a solid crest knob at its apex (missing on PW11-1101); a thickened lower rim projecting on the back side as a neck guard; a rope motif running around the lower rim and neck guard (fig. 11); and, inside the rope pattern, at least two incised lines (difficult to discern on PW11-0010) around the rim and neck guard. The same decorative features are present on the example in the Favignana museum. After cleaning of PW11-0010, PW11-0011 and PW11-0032, the rope pattern is seen to be twisted in opposite directions on the left and right sides until meeting at the center line. An additional basket-weave pattern runs inside the rope pattern and below the incised lines of the neck guard on PW11-0010. All of the crest knobs seem to be cast and appear seamlessly integrated with the helmets;

TABLE 2
SELECT MEASUREMENTS AND DESIGN ELEMENTS OF BRONZE HELMETS

	PW11-0010	*PW11-0030*	*PW11-0031*	*PW11-0032*
Find location	PW-A	PW-A	PW-A	PW-A
Missing dome	35%	-	45%	-
Max. h.	23.4	21.2	26.0	27.1
Max. diam: neck guard to brim	29.6	24.3	27.3	27.2
Max. diam: ear to ear	25.0	19.8	23.8	23.1
Max. diam: brim to neck guard	26.1	21.8	24.8	24.5
L. of neck guard at center	3.5	3.1	3.1	3.0
Distance ear to ear at mid h. (interior)	21.0	18.4	19.4	20.2
Th. neck guard at center	0.3	0.4	0.4	0.5
Th. brim center	0.4	0.4	0.7	0.7
Diam. of neck guard at brim mid h. (int.)	23.4	19.8	21.6	22.2
Knob h.	-	2.3	2.8	3.3
Knob max. diam.	-	2.4	2.7	2.9
Th. at break at mid h.	0.1	-	0.2	-
Percent encrusted	90%	80%	95%	95%
Rope decoration	X	X	X	X
Incised line pattern	X?	X	X	X
Rope extension from ear	0.4	0.7	1.2	0.5
Approximate neck guard angle	40°	40°	15°	15°

they are solid metal in their upper portion and do not have holes for attachments. Where discernible, the crest knobs are decorated with a molded pattern of a central circular element with outward radiating spokes. What appears to be possibly a semicircular chaplet is located at the center front edge of helmut PW11-0010; no attachment evidence is found on the interior opposite this feature.

Both bronze cheekpieces (fig. 9) were thin (from 1.0 mm at their edges to *c.*2.0 mm at their centers) and both have two forward projections for guarding the cheekbone and jaw. The more intact (PW11-034-002) is nearly 15.0 cm long and 8.5 cm wide, with forward projections *c.*3.0 cm long. The bronze hinge (PW11-034-003), *c.*11.0 cm long, found within the Egadi 6 ram, aligns perfectly with the opposite hinge projections on the cheekpieces. The hinge itself is a flattened bar with two flat projections at each end curled on their extremity; the angle of the curl when found was *c.*180°. Projections for hinge connections at the top of cheekpiece PW11-034-002 were formed from similarly-folded flat projections, and the angle of their curl was also *c.*180°. At some point the cheekpieces and hinge were separated from their respective helmets, when the curled projections pulled open to some degree; originally they were folded by more than 180° to secure them tightly. Centrally at the top of the hinge piece, on the opposite side from the projections, is a portion of an

upward-projecting ring (inner diameter *c.*0.4-0.5 cm) to hold the fastener connecting the cheekpiece to the helmet; this connector allowed the cheekpiece to swing and maintain a roughly perpendicular angle to horizontal blows. Given the angle of the hinge attachments and the shape of the cheekpieces, their lower portion would have hung slightly canted forward so as to protect both the ear and jaw. After cleaning, the hinge connections on the helmets are clearly discernible on the interior where part of the hinge survived. There are two hinge connections on each side, situated forward of the midline so as to align with the jaws forward of the ears. As there are two attachment points for each cheekpiece on these helmets, they differ from the helmet-hinge attachment for PW11-034-003 that has a single attachment point. An additional hinge attachment was found at the center point of the neck guards of each helmet. Here a single pin held some type of hinge on the underside of the neck guard, where an additional guard was attached.

Italy of the 4th c. B.C. saw wide variations in bronze weaponry, including helmet styles, which included the Attic and Chalcidian types in Etruria, the Negau type in N Italy, and the Apulo-Corinthian type in S Italy. A significant change in Roman weaponry occurred with the development of the maniple at the end of the 4th c. B.C. This included adoption of the Montefortino type of helmet (*galea* or *cassis*), an Italo-Celtic hybrid originating in what is now France and Austria during the 5th c. B.C. This helmet style is the most prominent in Spain, Gaul and Italy during the 3rd c.[27] It is unclear what types of armor Carthaginian marines or infantry utilized, but we know they employed Celto-Iberian mercenaries as well as mercenaries from S Italy. Therefore it is not possible to be sure of the cultural affiliation of the helmets based solely on their style, but a graffito incised over the molded decorative pattern on the crest knob of helmet PW11-0030 (fig. 11), which appears to form a letter corresponding to a Punic "he" (H) or Celto-Iberian "E",[28] may give a clue.

The helmets from sector PW-A derive from an artifact assemblage with a known context in the mid-3rd c., whereas other examples of Montefortino helmets are rare outside funerary or votive deposits (excavations on land or battle sites typically do not yield helmets in context[29]) and as a result their chronology is less secure. Many examples come from 4th- to 2nd-c. graves, such as the Alfedena necropolis, burials at Chieti (Contrada Sant'Anna), Villafonsina and Villamagna in Chieti, and Pretoro, or from the votive deposit at the sanctuary of Pietrabbondante. Those helmets may be spoils from Roman forces or their Campanian-Sabellian allies. Comparative examples are found at the Museo Guarnacci (V54), dated to the 4th c., and in the British Museum (dated to the era of the Punic Wars); there are also some 3rd-c. examples from Perugia and Bologna (fig. 11).[30] The form of the Egadi cheekpieces is comparable to the examples shown in fig. 11; they are also of a design common to later finds known from the Agen and Port areas, which came to typify that used throughout the Republic.[31] However, the comparative examples of fig. 11 have a more rounded dome than the somewhat pointed and taller domes of the Egadi helmets.

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27 Goldman (forthcoming) discusses the history of Republican-era armor and the archaeological evidence.

28 P. Schmitz kindly reviewed this graffito. There does not appear to be an analogous Latin character after the 6th c. B.C., nor any such Greek letter-form.

29 Bishop and Coulston 2006, 65.

30 The example from the British Museum (inv. AN 14094001, reg. num. 1975,0603.1, Greek and Roman Antiquities cat. no. Bronze 2726) is 21.7 cm in diameter and 19.2 cm high, with a slightly shorter crest knob. See other comparative examples in fig. 11.

31 Bishop and Coulston 2006, 65.

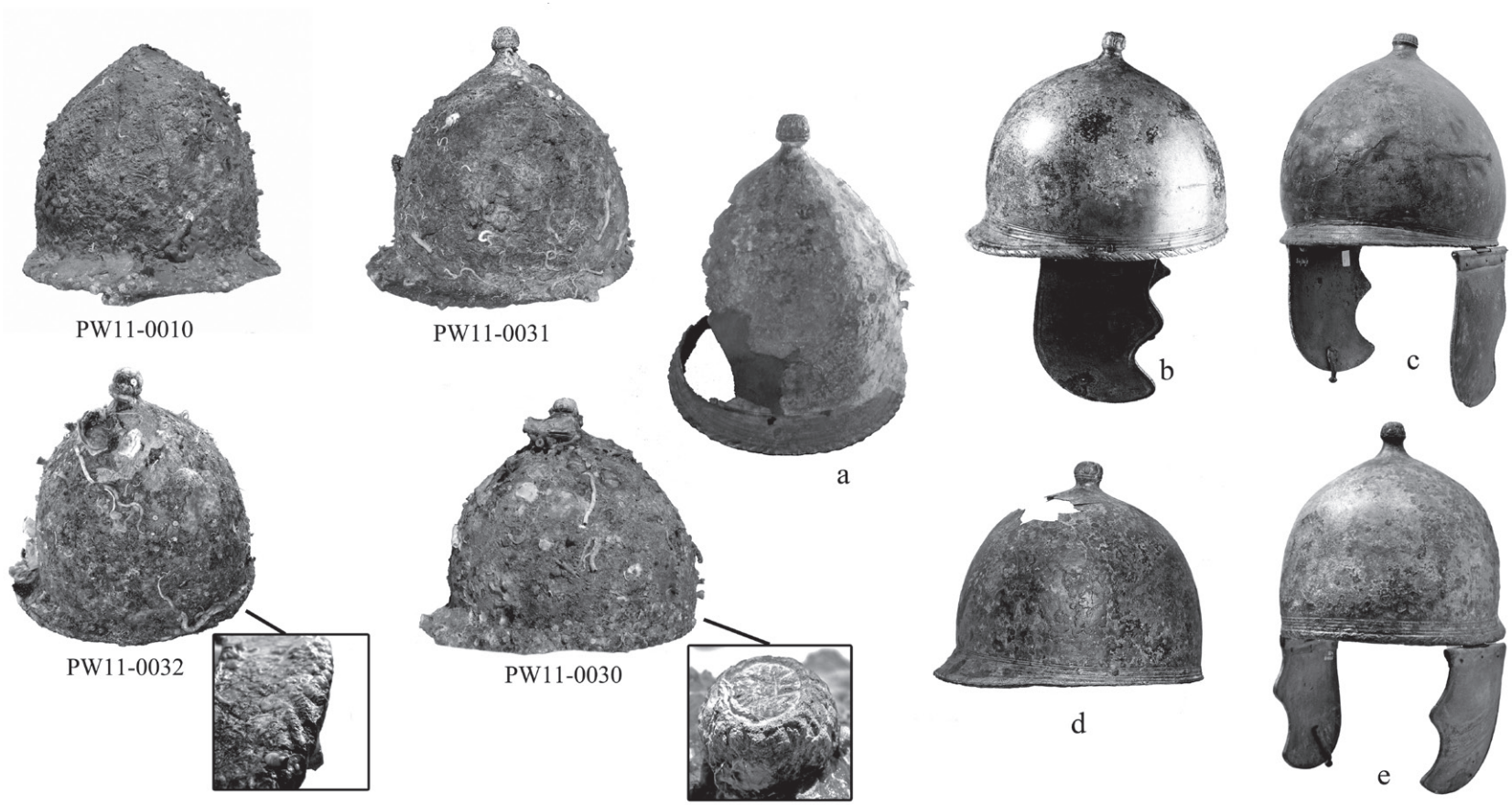

Fig 11. Bronze helmets from site sector PW-A (photos by J. Royal). **a:** helmet in Favignana Maritime Museum reportedly raised by fisherman (J. Royal, with permission of Favignana Maritime Museum). **b:** Museo Civico Archeologico di Bolgna, Benacci necropolois, example from grave 953, inv. MCABo 28233; (image and information provided by L. Minarini, Museo Civico Archeologico di Bologna, and Museo Archeologico Nazionale di Perugia). **c:** from San Giuliana (inv. SG/36/1). **d:** Frontone (inv. 362 from tomb 14/6/1886), and **e:** Monteluce (inv. 324 from tomb 19/4/1887 and one from tomb 5/2/1887, dated to 350-300 B.C.) (images and information provided by M. Pagano, Soprintendente per I Beni Archeologici dell'Umbria).

Amphoras

In 2009, three Greco-Italic type V/VI rim-neck-handle fragments (PW09-0004, 0005 and 0006) were collected from sector PW-B because of their 3rd-c. B.C. date and their proximity to the Egadi 2 ram, and another Greco-Italic V/VI amphora (PW09-0001) was collected *c.*1.75 km south of sector PW-B. All were found directly west of Levanzo Island near the junction where the rocky area meets the sandy area covered with drag-net scars. In 2010, however, many amphoras were noted near the Egadi 3 ram in sector PW-A, and one Punic amphora (PW10-0001) lying 146 m southwest of that ram was collected. In 2011, further ROV operations in sector PW-A revealed a field of amphoras, including various Punic types and Greco-Italic V/VI. Limited investigation within an area of 1 km^2 documented the locations and depths of 177 amphoras, nearly 70% of them being intact. The search pattern covered *c.*30-40% of the seabed within the 1 km^2; the random search strategy employed indicates that amphoras remain to be located in the unexplored areas; the full extent of sector PW-A is also still to be determined.

All the amphoras are distributed in a scattered pattern with no concentrated groupings of the kind typically associated with merchantman wrecks (fig. 2). This distribution was probably created by amphoras spilling from ships at the surface and/or while moving downward from the surface through the water column. Five were raised for analysis: 4 Greco-Italic V/VI (PW0011-0001, 0002, 0003, 0011) and one Punic (0004). The Greco-Italic V/VI amphoras from 2009 and 2011 are identical. To judge by the heavy N-S dragnet scars that delimit the E edge of sector PW-A, dragnets must have moved and broken apart amphoras from somewhere east of sector PW-A towards the north-northwest, where the nets struck rocks and dumped the material in our sector PW-B. Many other amphoras from east of sector PW-A were undoubtedly collected and retrieved in nets, an occurrence well attested in the area that accounts for many of the finds turned in to local authorities by fishermen. The same phenomenon accounts for the Egadi 2 ram being moved to its more northerly location in sector PW-B; as with the amphoras, it was probably originally deposited to the east of sector PW-A. Likewise, Egadi 7 was collected in nets some years ago. This means that the original eastern extent of the artifact distribution in sector PW-A (i.e., part of the conflict area) is severely disturbed; it may indeed have extended a kilometer or more farther east.

Punic amphora types (Table 3)[32]

Amphora PW10-0001 (fig. 12) is a Ramon type T-9.1.1.1/2 with a production date in the second half of the 3rd c. B.C. and a distribution that increases during the following century. These amphoras were produced in the area of Cadiz and on Ibiza, and are common finds in Punic Sicily, Malta and at Carthage.[33] Amphora fragments PW11-0004 and 0005 (fig. 12) are Ramon type T-3.2.1.2; additional examples of this type were noted on the sea-floor (see, e.g., fig. 12, lower left). Production areas for the type include N Africa (perhaps around Carthage) and W Sicily. The type circulated in the W Mediter ranean around the mid-3rd c. B.C. and particularly in the last quarter, and is a common find on the coast of Spain.[34] A small fresh break on an older broken edge of PW11-0004, as well as breaks at both ends of fragment PW11-0005, revealed a red fabric with

32 All Punic amphora identifications were corroborated by R. Docter (Ghent University) based on images and measurements.

33 Ramón Torres 1995, 289-91; Di Stefano 1993, 40

34 Ramón Torres 1995, 183 and 519-20; Ramón *et al.* 1998; Gómez *et al.* 2006.

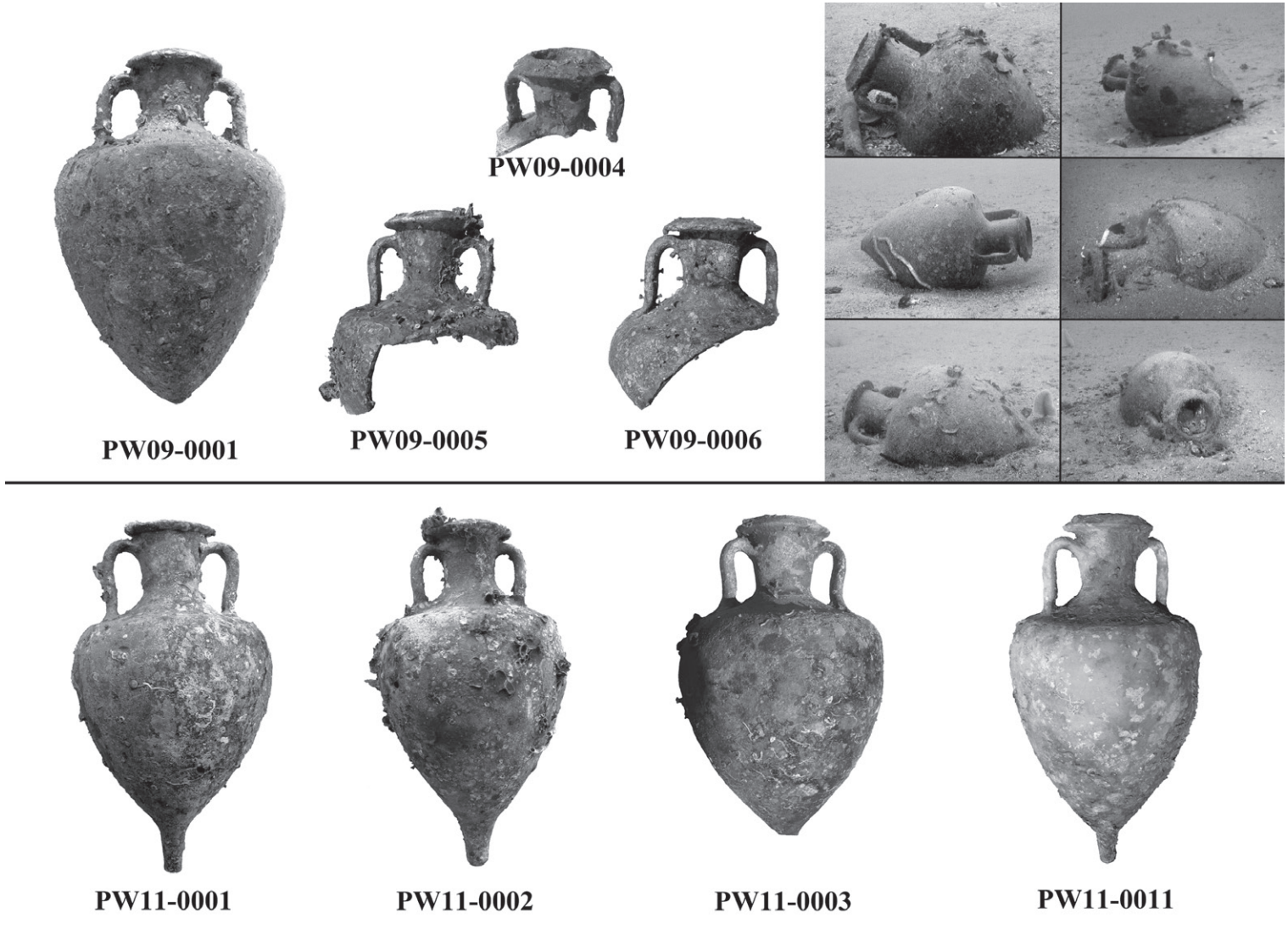

Fig 13. Greco-Italic amphoras raised from site sector PW-B (PW09-0004, -0005, -0006), site sector PW-A (PW11-0001, -0002, 0003, 0011), between site sectors PW-A and PW-B (PW09-0001), and remaining on seafloor in site sector PW-A (upper-right).

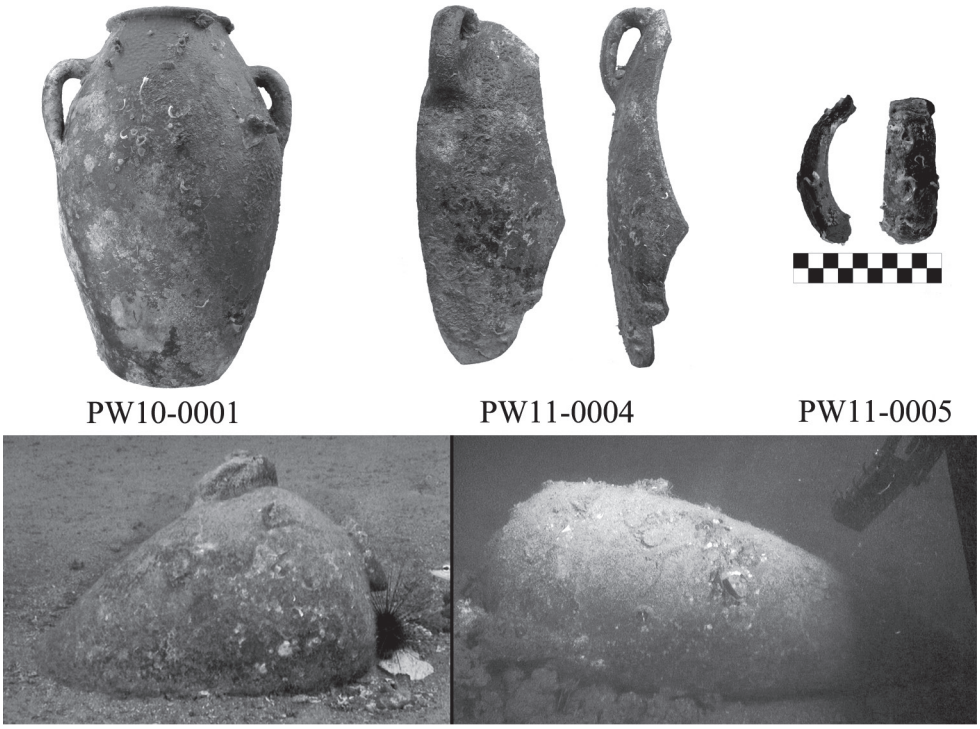

Fig 12. Punic amphoras in site sector PW-A: raised (above) and remaining on seafloor (below).

TABLE 3
RAISED PUNIC AMPHORAS: 2009-11

Attribute	*PW10-0001*	*PW11-0004*	*PW11-0005*
Condition	intact	frag.	handle
Typology	T-9.1.1.1/2	T-3.2.1.2	T-3.2.1.2
Max. ht.	36.5	45.8	10.0
Max. diam.	23.3	19.8	3.8
Handle shape	Ear	Ear	Ear
Handle ht.	10.7	13.4	(13.5)
Handle l.	14.6	19.4	(20.0)
Handle section - M	3.0 x 2.2	3.5 x 2.1	3.5 x 2.0
Rim diam. - O	13.2	-	-
Rim diam. - I	10.1	-	-
Rim ht.	0.7	-	-
Rim type	Flared	-	-
Neck ht.	N/A	N/A	-
Body th.	-	0.6-0.8	-
Base diam.	12.6	-	-
Base indent depth	2.8	-	-
Fabric color outer	2.5YR 3/4	-	-
Fabric color inner	-	10R 2.5/6	10R 2.5/6

M = Middle
O = Outer
I = Inner

numerous small black and sparse white inclusions. Comparanda include those from the necropolis at Lilybaeum,[35] Xlendi harbor on Malta,[36] and various sites in Spain.[37]

35 Di Stefano 1993, 59, pl. 4.3.
36 Gambin 2002-3, 21, fig. 3.
37 Ramón Torres 1995, figs. 156-57 and 244.

TABLE 4
RAISED GRECO-ITALIC AMPHORAS (2009-11)

Attribute	*PW09-0001*	*PW09-0004*	*PW09-0005*	*PW09-0006*	*PW11-0001*	*PW11-0002*	*PW11-0003*	*PW11-0011*	*Avg.*
Condition	intact	frag.	frag.	frag.	intact	intact	intact	intact	
H. with toe	-	-	-	-	68.5	64.5	-	76.1	69.7
Body h. without toe	59.0	-	-	-	59.3	59.0	61.2	67.7	61.2
Diam.	38.0	-	38.5	-	35.0	36.2	39.4	37.5	37.4
Handle h.	13.0	-	12.6	13.0	13.5	13.0	12.8	14.0	13.1
Handle section - M	3.2 x 2.8	3.0. x 2.4	3.0 x 2.7	3.0 x 2.6	3.1 x 2.0	3.3 x 2.5	3.9 x 2.7	4.1 x 2.3	3.3 x 2.5
Rim diam. - O	17.9	18.0	18.0	18.0	17.3	18.5	17.0	17.2	17.7
Rim diam. - I	11.8	12.0	12.5	12.0	11.2	11.9	11.8	11.7	11.9
Rim h.	2.8	2.4	2.7	2.6	2.0	2.5	2.9	2.5	2.6
Carination h.	-	-	-	-	47.0	50.0	-	54.2	50.4
Neck h.	9.8	10.5	10.0	9.5	10.0	11.0	10.2	11.1	10.3
Neck diam. - M	11.0	11.5	9.5	11.0	11.6	10.2	10.8	11.1	10.8
Body th.	-	0.9-1.2	0.8-1.1	0.9-1.1	-	-	-	-	1.0
Toe length	-	-	-	-	9.2	11.0	-	8.4	9.5
Toe diam. - M	-	-	-	-	4.5	5.5	-	3.8	4.6

Greco-Italic V, V/VI amphoras (Table 4)[38]

All of Greco-Italic amphoras collected from both sectors PW-A and PW-B (fig. 13) have thick triangular rims, upward conical necks, strongly carinated shoulders, tapered bodies, and a short toe. All but one rim slope downward from the inner to outer rim edge; amphora PW11-0001 has less of a slope and forms a slightly flatter rim. Each amphora features one handle having slightly more curvature than the other (note, e.g., the particularly asymmetrical amphora PW09-0005). Two general handle profiles are seen: those that are slightly more vertical (PW09-0001, -0006, PW11-0011) and those with greater curvature (PW09-0004, -0005, PW11-0001, -0002, -0003). Typically the joins of the handle to the neck and shoulder are not worked to a smooth finished surface. A slight ridge runs along the midline of the handles' outer face on PW09-0004 and PW11-0002. Amphoras with intact bases feature a small toe (between *c.*4 and 6 cm in length) solid in its bottom third; one example (PW11-0001) flares slightly at the terminus while on others (PW11-0002, -0011) it remains straight. Where there was a fresh chip or an old break that could be cleaned, the fabric color was consistently 2.5YR 4/6 with a few black and a moderate number of white inclusions.[39] Construction marks include ridging on the interior necks of PW09-0004, PW11-0003, and possible finger indentations associated with the joining of the base of at least one handle to the shoulder on PW09-0001, -0005, and PW11-0002. An incised line is seen around the base

38 All Greco-Italic amphora identifications were corroborated by G. Olcese (Università La Sapienza) based on images and measurements.

39 Thin-section analysis is planned to determine production areas for the amphoras. Petrological analysis should allow differentiation of production between the Bay of Naples and individual regions in Sicily or N Africa. Greco-Italic amphoras from Ischia are typically very similar in fabric, the light beige color tending to pink (5YR 6/6-5YR 7/3) or brown (10YR 7/3); among the inclusions visible to the naked eye are grains of volcanic material and flakes of mica (Olcese 2004, 179) since the clays from Ischia have volcanic inclusions and limestone with microfossil inclusions (Thierrin-Michael and Galetti 1996). Greco-Italic amphoras are also found in local fabrics at Portus, Sabratha and Carthage; the fabrics from N Africa are fine-grained and typically have numerous quartz inclusions, sometimes with limestone too.

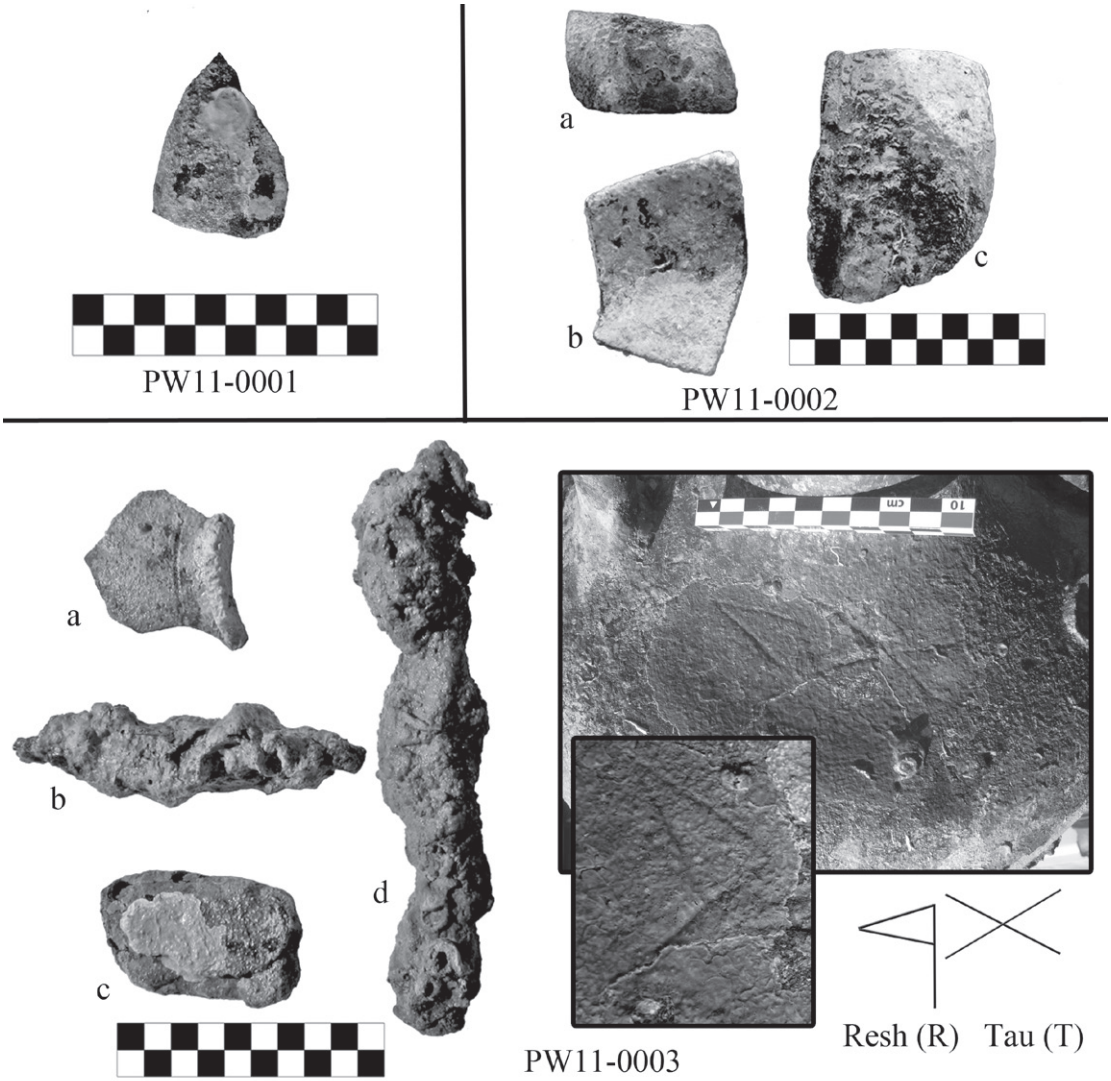

Fig 14. Finds within Greco-Italic amphoras from site-sector PW-A. PW11-0001: ceramic sherd. PW11-0002: ceramic sherds (a-c). PW11-0003: ceramic sherd (a), tile fragment (c), iron nails (b, d), and graffito on amphora's shoulder.

of the neck on PW09-0004, PW09-0006, and PW11-0003, and possibly PW09-0005, while an incised line runs around the top of the neck on PW11-0002. Around the bases of PW11-0002 and 0003 near the toe join are 1-2 incised lines. No stamps were noted on any handles or rims, but a Punic graffito is located on the shoulder of PW11-0003 (fig. 14) that reads "Resh Tau".[40]

The Greco-Italic amphora type[41] is a relatively long-lived form that was widely

40 P. Schmitz (Eastern Michigan University) kindly reviewed the graffito and letter-forms.

41 Also known as type MGS V and VI amphoras (Van der Mersch 1994), previously categorized as Will A1 and A2. Will (1982) provided a summary of work on Greco-Italic amphoras and the history of its typology up to the early 1980s. Subsequent fieldwork in Sicily and Italy produced numerous finds of this type and it was proposed that Greco-Italic amphoras were manufactured in Magna Graecia/Sicily between the 5th and 2nd c. B.C. (Van der Mersch 1994), which gave rise to the 'MGS' designation referring to a production area (see, e.g., Caravale

produced and distributed throughout the Mediterranean. The numerous amphoras from sector PW-A are the Greco-Italic type V to V/VI, demonstrating a 3rd-c. form at the transition between V and V/VI.[42] Type IV Greco-Italic amphoras (mid-4th c.) have a more elongated shape, longer handles, a greater amount of shoulder slope, a straight conical neck, and a more flaring rim. Type V amphoras are dated by contexts at Ischia to the late 4th through mid-3rd c., while types V and V/VI range from the end of the 4th into the 2nd c. B.C.[43] At Ischia, the type V amphoras have a rim that is not as wide as in the earlier phase, a slightly wider and more 'V'-shaped body, and a tronco-conical neck compared to the earlier cylindrical neck.[44] The rim form, angle of neck, and body shape of the type V-V/VI amphoras from sector PW-A are consistent with a date in the mid-3rd c. B.C. They were once thought to have been produced only in Italy and Sicily, but discoveries of kiln sites coupled with petrological analyses now point to additional production areas. Earlier work suggested Spain and Sicily as the primary source areas, but newer evidence indicates S Italy, the central Tyrrhenian coast from Cosa to Pompeii including Portus,[45] Velia, as well as southern France (Pech Maho) as production areas. Production occurred on Ischia from the late 4th to 3rd c. for types IV and V, and for type V/VI to the end of the 3rd and into the 2nd c. B.C.[46] Greco-Italic amphoras are also found in N Africa at Sabratha and Carthage made in local fabrics.[47] The graffito points to a Carthaginian cargo originating in Tunisia, but the planned thin-section analysis may modify this.

Closely comparable amphoras were carried on the Montecristo A shipwreck off Tuscany, variously dated to the early to mid-3rd c. B.C.[48] Other comparable examples around Sicily include the Secci di Capistello wreck[49] (first quarter of the 3rd c.), the Roghi di Panarea wreck[50] (recently re-dated to the second quarter of the 3rd c.), and the Filicudi B wreck[51] (end of the 3rd c.), all found around Sicily. Comparable examples are found at Lilybaeum.[52] From the Cala del Diavolo wreck off the Tuscan coast come early to mid-3rd c. examples with a height range of 65-70 cm and thick, triangular rims.[53] An early 3rd-c. example also comes from Barbarossa at Porto Azzuro on the same coast.[54]

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and Toffoletti 1997, 82-89, who differentiated Greco-Italic amphoras by the generally-accepted chronological categories of I through VI, but maintained the MGS designation).

42 The primary designation for the types follows Olcese (2007, 64, fig. 2). Van der Mersch (1994) classifies the types as V and VI = Will A1 and A2.

43 Olcese 2004, 177; ead. 2007, 70; Caravale and Toffoletti 1997, 88-89.

44 Olcese 2007, 64-65.

45 Most of the study examples were in contexts of the late 3rd to 2nd c. B.C.: Grace 1952; Will 1982; Peacock and Williams 1991, 85. For Sicily see Alaimo *et al*. 1997, 62. For Pompeii, see Mannoni 1984. For Velia, see Liko 2001a and 2001b. For France and the Tyrrhenian coast, see Hesnard *et al*. 1989 and Thierrin-Michael 2000. For Campania, see Olcese 2004. For kiln sites at Cádiz and in the Straits region, see Sáez Romero and Díaz Rodríguez 2007; Sáez Romero 2008.

46 Olcese 2004, 176-79; ead. 2007, 70.

47 See Roman Amphorae: a digital resource (University of Southampton, 2005), http://archaeologydataservice.ac.uk/archives/view/amphora_ahrb_2005/petrology.cfm?id=141&CFID=0&CFTOKEN=4BA6E221-2C63-4CFD-BDC6495EAE7C0E1A (viewed Oct. 24, 2011).

48 Martelli 1982, 65-68; Corsi 1998, 137-43.

49 Frey *et al* 1978.

50 Bernabò Brea and Cavalier 1985, 69-70. The amphoras are re-dated in Olcese 2010, 248.

51 Bernabò Brea and Cavalier 1985, 88-89.

52 Di Stefano 1993, 59, pl. 4.1.

53 Maggiani 1982, 67.

54 Rossi 1982, 85, fig. 76.

Artifacts were found within three of the intact amphoras from sector PW-A (fig. 14). Amphora PW11-0001 contained a large amphora body sherd, while PW11-0002 contained several coarseware sherds, including one rim fragment. This material is consistent with wares common to Punic N Africa and W Sicily in the 3rd c. Amphora PW11-0003 contained the rim of a small coarseware container, a tile fragment, and two iron nail concretions (12 and 21 cm long) clearly from ship timber attachments, like those found within the Egadi 3, 4 and 6 rams, while the tile fragment is similar to fragments found within the Egadi 4 and 6 rams. As these three amphoras were found in a small triangular area (16 x 19 x 34 m) over 200 m from the findspots of the Egadi 3-6 rams, possibly they were close to a different wreck from the wrecks associated with the rams which have been documented thus far.

Discussion

The larger context of the archaeological evidence

The study of human behavior in the past is a process by which hypotheses are put forward on the best available evidence to date and then critiqued for their ability to explain that evidence. New evidence often prompts novel ideas to be put forth. The Egadi rams and the other evidence from the battle zone offer important new data sets for addressing questions relating to warships. In his substantive contribution to this field of inquiry, J. S. Morrison provided an honest assessment of the evidence on which warship reconstructions had been based to date:

> A naval architect attempting to reconstruct ancient Mediterranean warships is offered scanty literary and iconographical evidence on which to draw.[55]

The problems of interpreting literary and iconographical sources are well documented; likewise, the limits of the archaeological data must be addressed. The material associated with the Battle of the Egadi Islands is pertinent to warships and their operation in the 3rd c. B.C. only. The cultural material from the Egadi Islands provides evidence for the location of the events associated with the battle, the depositional fates of the warships from this battle, and the size of the warships that engaged in this specific conflict. Comparisons can be made to remains from different eras, such as the Athlit ram or Augustus' Victory Monument at Nicopolis, but the results will be limited to general diachronic changes.

For the class sizes of the rams lost during the battle we have an inconclusive literary record. The nomenclature is not likely to have been consistent over more than seven centuries or between the different cultures using it and it is unwise to assign the same meaning to references for "threes" or "fives" in the 4th c. B.C. and those in the 1st c. A.D. There was undoubtedly evolution and innovation in warship design and their armament: differences are already seen in the archaeological record between the 3rd-c. rams from the Egadi Islands and those of the 2nd c. B.C. We will focus on likely sizes from design considerations.

From conflict area to battle landscape

In view of the range of potential routes for the Carthaginian fleet travelling from Marettimo Island towards Bonagia Bay, and for the possibility that the Roman fleet rounded the N tip of Levanzo Island to meet them (Polyb. 1.60), the naval engagement took place west of Levanzo (fig. 1). Although only a small percentage of the known artifact distribution (*c*.1 km^2) has been examined thus far, the dispersion of artifacts in sector PW-A supports

55 Morrison 1996, 297.

this narrative of events. This convergence between the archaeological and the historical record is in itself an important result. Given the hundreds of warships engaged in the battle, actual conflict would initially have extended over perhaps 7-10 km, and probably expanded as the conflict unfolded. Unfortunately, material east of sector PW-A has been removed or displaced by dragnets, making it impossible to ascertain the original extent of the battle zone hereabouts. Additional finds will be made to the degree to which sector PW-A extends to the west, and if other distinct battle zones are undamaged. Nevertheless, the undisturbed nature of the material in sector PW-A already permits a discussion about a battle landscape.

Intensive recording methodologies to detect small objects, in addition to the larger rams and amphoras, will be necessary to comprehend it better. Precise mapping of all artifacts could allow inferences to be made about the nature of ship-to-ship conflicts, the expanse of the conflict, and what material from a naval battle can be expected to survive in the archaeological record. Through a combination of the possibly associated evidence of anchorage on Levanzo Island, the finds at Bonagia Bay, the excavations at Marsala, and ongoing maritime investigation around the Egadi Islands, a battle landscape is coming to light. It may eventually be possible also to consider strategic and tactical operations, ports and anchorages, and land support.

Depositional fates of warships

The fate of warships becoming swamped is well-attested in literary sources. A fresco of a warship wrecked along the shore in the Temple of Isis at Pompeii is evidence that such a ship swamped and floated ashore. However, a common misconception about ancient warships is that they could not, and did not, sink, even though thousands of ancient ships of all eras did sink. Instead, it is proposed that warships simply floated on the surface swamped with water and awash until they were towed away by friend or foe or crashed into a nearby shore in every instance.[56] Statements from ancient authors are only moderately helpful as they typically refer, in an abbreviated or imprecise manner, to 'destroying' a vessel.[57] Yet Lucan (*Phars.* 3.627-33) distinctly mentions a warship sinking beneath the surface, and Polybius (1.60-61.6) uses the word *katedusan* which seems to mean "to sink into the water".[58] The underlying basis used to argue that warships could not sink is that wood floats, but this simplistic observation fails to understand the nature of ships or the changing state of the wood in their hulls. Most (but not all) wood species have a specific gravity less than 1.0 (that of water) and therefore float, but the specific gravity for wood is not a constant. Over time the wood in ships' hulls becomes waterlogged through immersion, spray and humidity; water is absorbed into the wood cells up to the fiber's saturation point and then is absorbed in liquid form into the wood's cell cavities and pores, which increases its mass and raises its specific gravity.[59] As the specific gravity of the wood in hulls increases, its ability to carry additional mass decreases in an inversely proportional manner.[60] Metal fasteners, lead sheathing, rigging gear, anchors and other metal fixtures attached to ships'

56 For such an example, see Strauss 2004, 198-208.

57 E.g., Diod. 11.24.1-2.

58 W. M. Murray kindly brought these references to our attention.

59 In the analysis of the Acqualadroni ram, the specific gravity of most wood samples equalled or exceeded the value of water: Romagnoli 2009, 6, Tables 1-2.

60 Although ships may have been regularly hauled out and degraded hull sections replaced, water remained to some degree; further, during naval operations the water absorption accelerated greatly and raised a hull's mass.

hulls increased their overall mass.[61] Shipwrights have understood the nature of wood for millennia: they designed hulls to attain buoyancy through the displacement of water (a ship), rather than relying on the buoyancy (specific gravity) of the parent construction material (a raft). All ships' hulls are waterlogged to some degree, and some more than others; in the 4th c. B.C., warships in the Athenian fleet with less waterlogged hulls were considered the best and fastest ships (ταχυναυτοῦσαι), but this implies that there were also warships with more waterlogged hulls that were in a less ideal state for battle.[62]

A further assumption lying behind the 'non-sinking' premise is that warships were virtually empty shells during their operation, carrying no shipboard items, cargo or ballast on-board. But the notion that any vessel that operated by both oar and sail propulsion, with numerous individuals on board, and in conflict situations, did so without equipment, stores and ballast on board is contrary to a basic understanding of how a ship operates. The ship's own tools and equipment, containers, weapons (both of the ship and personal), and other equipment belonging to those on-board must be taken into account. It is this heavy equipment necessary for long-distance navigation that ancient authors note is removed when possible before entering into an engagement with enemy ships. As with Renaissance war galleys,[63] ballast was mandatory to counter the forces placed on the vessel by the sails, and weight must have been concentrated below the waterline in warships' hulls, particularly as they were long and narrow. Thus the stones found at the site of the ship that carried the Egadi 4 ram are not surprising.

The evidence from our survey shows that entire warships sank to the seafloor along with their rams. This is contrary to the commonly accepted belief that warships never sank when destroyed, but floated in a swamped condition at the water's surface. In certain conditions, however, it now seems likely that warships could and did sink, taking their rams and associated bow timbers to the bottom. Such a conclusion is really not so radical. Ancient warships were often required to carry heavy loads of supplies, siege machinery, and so on. In the case of this battle, the Carthaginians were sailing their warships laden with supplies to the Egadi Islands when the Romans suddenly engaged them (Polyb. 1.61.4-6; cf. Livy 36.43.6-7 for an instance of laden warships in 191 B.C.). The dispersion of amphoras and finds of armor in sector PW-A accord well with Polybius' account of the Carthaginian ships being heavily laden with supplies and troops. The vessels operating at the Battle of the Egadi Islands were warships, not war-rafts; once breached by ramming attacks during the battle, their hulls filled with water. The hulls lost the buoyancy attained from displacement and the waterlogged hulls had less ability to carry the additional mass; the rigging, ship's equipment, armaments, ballast and particularly the cargoes in the Carthaginian warships all raised the overall mass to a point where the warships sank to the bottom.[64]

The discovery since 2008 of 9 waterline rams provides evidence to counter the belief that rams broke off their warships' bows along with the bow timbers, and that, while the

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61 Hence, it is not uncommon to encounter wooden hulls on the seafloor that are not also encumbered by a cargo. Examples directly familiar to the authors include sites TK06-AD (Royal 2008a, 93-95; Royal and McManamon 2010, 331-39), AB10-AB and AB10-AC (http://www.rpmnautical.org/albania2010.html), Tantura A and Tantura B (Kahonov and Royal 1996; Kahanov *et al.* 2002), and the Marsala Punic wreck (Frost 1974).

62 Cf. Gabrielsen 1995, 235 n.6 and *IG* II^2 1611, lines 97, 147, 151, 157.

63 D'Agostino *et al.* 1997; Royal 2008a and 2008b; Royal and McManamon 2009 and 2010.

64 Coates (1995, 133-34) already put forward this logical observation.

rams sank due to their weight, the bow-less warships remained afloat.[65] First, such a belief is at odds with the archaeological evidence for ship construction, in which the keel, main wales, ramming timber, and stem timbers at the bow (on which rams were fitted) came together to form one of the strongest unions in a hull.[66] Analyses of the timbers inside the Athlit and Acqualadroni rams reveal a complex system of scarfs, bevels, rabbets, tenon and nail attachments that resulted in a fully integrated unit at the bow. In addition, heavy knees, frames, and deadwood contributed to the hull's strength at the bow. A hull's bow requires heavy construction to absorb intensive shock forces from waves. The sheering off of a warship's hull at the bow aft of its ram would involve the complete breaking of the keel, both wales, both garboards, the stem, numerous strakes, deadwood, and any chocks or frames present. J. R. Steffy noted the implausibility of bows becoming separated from the rest of the hull in his study of the Athlit ram:

> The ram and bow timbers were not wrenched from the ship; all aftward terminations are natural, eroded separations, and the unit shows no signs of violent distortion. It is, in fact, unthinkable that such a substantial assembly of timbers could be ripped away from the bow by any force existing in antiquity.[67]

The Egadi rams too remained attached to their bow timbers. The only damage and deformation is limited to their heads, linear damage, which points to ram-to-hull or ram-to-ram collisions.[68] The fragmentary rams show how rams were typically sheared from the bow. It is hard to imagine shipwrights repeating design flaws that would allow such a valuable item as a ram to be easily removed and lost at sea.[69]

Geological factors affecting various depositional environments can help explain the relative preservation of wooden hull remains. Shipwreck sites close to shore are generally found in thick layers of sediment resulting from run-off and fluvial transport, in which degradable material such as wood can rapidly become buried — a prerequisite for its survival in the archaeological record. Such was the case with the Athlit and Acqualadroni rams. Further offshore, accumulation of sediment is comparatively much less and occurs at a slower rate, so that the soft layers are typically thinner. Excavation at the Levanzo 1 wreck (which lies an equal distance from Levanzo Island as our sector PW-A), as well as of the sediment around Egadi rams 2 and 4, showed that the soft upper layer was 5-15 cm deep.[70] The underlying hard substrate restricts cultural material from settling below this upper soft layer. Without a protective sediment cover, warship timbers in sector PW-A

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65 Morrison *et al.* 2000, 222-23. Only one of these previously known rams, the Athlit, had a provenience. It presented evidence contrary to the present hypothesis but it was the only example.

66 The term 'bow' refers to the forward portion of ship's hull, typically where the sides begin to curve inwards toward the stem. It is not in itself a specifically constructed section separate from the remainder of the hull or demarcated by a particular set of structural elements. Hulls are single integrated structures; timbers such as the keel, strakes, and wales, for example, run from bow to stern. Descriptive terms such as 'bow', 'stern', 'port', and 'starboard' provide spatial orientation on-board a ship or when referring to areas of its hull.

67 Steffy 1991, 29.

68 Damage to the rams provides supporting evidence for the use of frontal ramming tactics into the 3rd c. B.C. (Murray 2011). The wood trapped at the head of the Egadi 6 ram suggests that ramming a hull could produce damage beyond simply opening planking seams.

69 See Murray's (1985, 145-47) analysis of ram values based on the records by the curators of the shipyards at Athens: for example, during the 4th c. B.C., Athenian trierarchs were expected to return to the yards rams from old ships or ships damaged in storms.

70 Royal and Tusa 2012.

were left exposed and were destroyed by teredo, resulting in the rams' attachments being left in place and the iron nail found in the interiors of both rams and amphoras. Some warships from this battle were destroyed at a distance of more than 7 km from the nearest shore on Levanzo Island, where the water was over 80 m deep and where of course there was no interplay with a shoreline. Not only did their heavily-laden condition prevent these ships from swamping or remaining afloat; if they had, the ships would have drifted far from the battle area where the cargos and armament were spilled. As the rams were found amidst the other materials, the ships must have sank to the bottom at the same time as the amphoras and armor. Wood remains, nail concretions, marine growth patterns and pXRF data from the Egadi rams (as well as the Acqualadroni and Athlit rams[71]) indicate they were attached to their warships' bows upon deposition. Hull attachments, tile fragments, ballast stones and coarseware from sector PW-A, as well as the amphoras themselves, point to highly degraded and scattered wrecksites. Clearly it was possible for the warships to sink, depending on their condition and the specifics of the materials carried on board; as a result, warship rams are found on the seafloor, in some cases with the bows partially preserved. This is not to say that warships sank in every instance, but, as with all other ships it is possible that they could sink. Whether they sank, swamped, or washed ashore depended on the interplay of specific warship operation/mission and the taphonomic processes specific to the depositional site.

Ram size and warship size

A striking characteristic of the Egadi rams is their small dimensions. The most useful measurement for comparing ram lengths is their driving centers, since the lengths of tailpieces vary and exaggerate the overall length of the ram. The driving center length of the Athlit ram is 1.575 m, of the Acqualadroni ram 0.950 m (both perhaps a century earlier or more); the Bremerhaven ram is 0.260 m and the Piraeus ram is 0.536 m (both probably at least a century earlier).[72] The driving center lengths of the Egadi rams fall within the range of 0.590 to 0.859 m. While a more detailed comparison of ram morphology and dimensions is slated for a later publication, it is clear that 10 of these 11 rams have a driving center length between roughly 0.5 and 1.0 m.[73] The Athlit ram is of exceptionally large size amongst warship rams found to date, yet is consistent with timber sizes of merchantmen of the 2nd c. B.C. as well as those found within the almost-contemporary Acqualadroni ram.

Several preliminary observations can be made regarding the dimensions of the warships on which the Egadi rams were fitted: the cross-sectional dimensions for the warships' wales can be ascertained from the rams' wale pockets, their keel dimensions calculated from the rams' bottom plates, and an indication of stem dimensions deduced from cowl measurements. Bottom plate-tailpiece shapes indicate that the keels of the warships were slightly trapezoidal at the bow, and were shaped oddly in that they had nearly the same molded and sided dimensions. Steffy, who noted similarly odd dimensions (molded 10.5

71 Romagnoli 2009; Steffy 1991, 29.

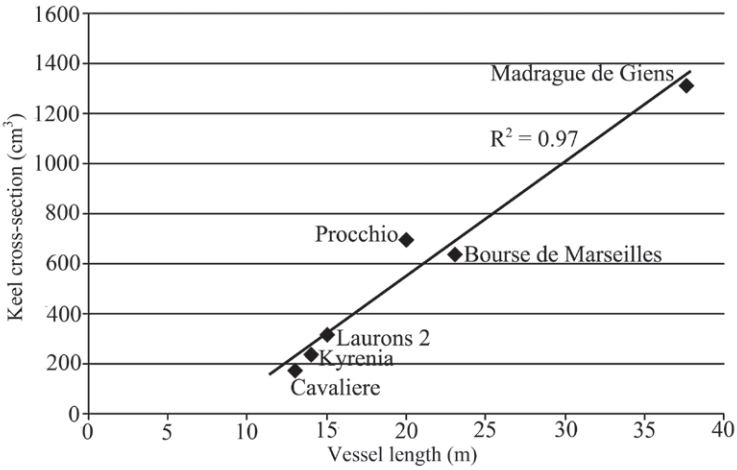
72 For the Athlit ram, see Steffy 1991; Acqualadroni ram, Tusa *et al*. 2012; Bremerhaven ram, Bockius forthcoming; Piraeus ram, Steinhauer 2006, 36-38 (measurements are both given and interpolated).

73 Although the Bremerhaven ram is comparatively short, it has head dimensions and overall width dimensions analogous to these 10 'typical' rams. A twelfth waterline warship ram, the Follonica ram, recently seized by Italian police in Rome, has no published dimensions but appears similar in size to that of the Egadi rams.

TABLE 5
WRECKSITES DATA FOR KEEL-VESSEL LENGTH CORRELATION

Wreck Site	*Date*	*Est. L.*	*Keel molded x sided (cm)*	*Keel cross section (cm^3)*
Kyrenia[1]	*c.*300 B.C.	14	10-13 x 20.3	233.5
Cavaliere[2]	100 B.C.	13	11.0 x 16.0	176
Madrague de Giens[3]	1st c. B.C.	37.6	33 x 40	1320
Procchio[4]	2nd c. A.D.	20	25 x 28	700
Bourse de Marseilles[5]	2nd c. A.D.	23	17-28 x 29	652.5
Laurons 2[6]	2nd c. A.D.	15	20 x 16	320

1 Steffy 1994, 42-52.
2 Charlin *et al.* 1978, 60-93.
3 Rival 1991, 147-239.
4 Zecchini 1982, 138-68, figs. 49-50.
5 Gassend 1982, 75-76.
6 Gassend *et al.* 1984, 93-94.



cm, sided 20.0 cm) for the keel timber preserved within the Athlit ram, surmised that the molded dimension increased aft of the ramming timber to a molded dimension of *c.*25.0 cm;[74] this resulted in an aspect ratio (molded-to-sided dimension) of 1.25, which is in accord with the structural demands required of the keel for ancient hulls.[75] If we allow for a similar increase in the Egadi keels' molded dimensions to attain a 1.25 aspect ratio, it is possible to estimate keel dimensions for the warships (Table 5) and calculate the cross-sectional area of the keels. A cursory review of ancient merchant ships indicates that the keel cross-sectional area and overall vessel length are strongly correlated (Table 5). Given that warships have a high length-to-beam ratio, they had a greater requirement for robust longitudinal support timbers, particularly the keel. The main wales at the warship's water line were other important longitudinal timbers within the hull, which sat in line with the ramming timber. The waterline was the area of stress in the hull for it is here that it gained and lost the support of the water for holding up the ship's mass; it was at this point that hulls were most likely to flex.[76] The sturdiness of a warship's main wales was crucial since they helped redirect impact forces throughout the hull.

Both the actual dimensions and cross-sectional area for keel and wale timbers in the Egadi warships were relatively small by comparison with those from merchantmen. Keel sizes for our warships were similar to the 14-m long Kyrenia ship (*c.*300 B.C.) and the 13-m

74 Steffy 1991, 17 and 34.
75 The value of the keel aspect ratio ("molded/sided dimension") in sea-going merchantmen of the later Roman period was typically between 1.0 and 1.75: Royal 2002.
76 Steffy 1994, 49-50. They were also at the waterline in the Athlit ram: Steffy 1991, 30.

Cavaliere wreck (*c.*100 B.C.).[77] Similarly, the wales on our warships were of relatively small dimensions (15-21 cm in width, 9-14 cm in thickness), comparable to those on the Kyrenia ship and the Bourse de Marseilles vessel (2nd c. A.D.) at 23 m in length.[78] Larger vessels such as the Madrague de Giens (1st c. B.C.) merchant vessel, estimated to be 37.6 m long, not only incorporated a large keel (40 x 35 cm), but also had a double hull totalling 10 cm in thickness, a thickness analogous to the wale timbers of our warships.[79] This is not to say that Egadi warships were less than 15.0 m in length, rather to illustrate the diminutive dimensions of the timbers and the general limits they dictate for hull length. As with the Athlit ram, the Egadi warships probably featured planking between the keel and wales that was thicker than would be found on contemporary merchant vessels. Given the likely construction method for warships that featured much heavier bottom strakes up to the first wale, there was additional longitudinal support. This would allow the construction of warships *c.*25-28 m in length, a size concomitant with a "three".

We have limited literary evidence for warships of the 3rd c. B.C. Although quinqueremes are the only class of warship attested specifically for this battle (Polyb. 1.59.6-8, 1.63.5) and generally emphasized for the First Punic War as a whole, triremes ("threes") and *lemboi* were also components of the fleets at this time (Polyb. 1.20.9, 1.53.9). In light of the new archaeological evidence, questions arise concerning the dimensions and configuration of the warships and how they relate to statements in the literary record. Previous hypotheses, based on literary and iconographic evidence, do not conform to the material from the Egadi Islands, which points to relatively small ships.[80] Polybius implies that quinquiremes ("fives") were involved in the battle. If his implication is correct, then the "fives" in this battle were surprisingly small and would conflict with his observation (1.63.8) that the "fives" of the First Punic War were much larger and more impressive than the "threes" of the Persian Wars. It is also unlikely that the 7 Egadi rams are a skewed sample of warship sizes within a given class in view of the probable population of rams deposited at this battle site. They most likely represent the actual, and typical, dimensions of a single class of warship in this period. Larger, or smaller, rams may be discovered, but these would undoubtedly represent another class of warship.

Given the size of the timbers, and thus warships, idicated by the Egadi rams, it is incumbent upon us to offer a hypothesis on the class of warship they represent. As noted, Polybius only relates the presence of "fives" at this battle. For the complement of Roman "fives" crossing from Sicily to Africa in 256 B.C., Polybius (1.26.7) enumerates 300 rowers and 120 marines.[81] It is clear that in the 3rd c. "fives" were large warships, and specifically larger than the warship remains from the Egadi Islands. L. Casson proffered the idea of a sin-

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77 For the Kyrenia ship, see Steffy 1994, 43. For the Cavaliere wreck, Charlin *et al.* 1978, 60-93.

78 The main wales on the Kyrenia ship were 8.0 cm wide and 21.5 cm thick (Steffy 1994, 49). Those on the Bourse de Marseilles wreck were 6.0 cm wide and 14.0 cm thick (Gassend 1982, 76-77).

79 For the Madrague de Giens vessel, see Tchernia *et al*. 1978, Pomey 1982, and Rival 1991.

80 For discussions, see Casson 1995, 100-3; Coates 1995, 138-39; Morrison 1995, 68-69; Murray 2012, 23-30. Here priority is given to the archaeological record, in which the Egadi rams are the only direct evidence for warships of the 3rd c. B.C, apart from Athlit which may be late 3rd c.

81 L. Casson (1995, 105) adjusted this to 270 rowers, 30 officers and crew, and 120 marines, still totaling 420 individuals. Whether or not 120 marines was the typical complement or not, the total number of individuals ascribed by the limited references to "fives" is well over 350. For additional discussion of "fives" having 300 rowers plus marines and crew, along with the necessary large size of such a vessel, see Morrison 1996, 270-71 and 285-94.

gle-banked "five" in the First Punic War supported by iconographic examples;[82] yet these "fives" would also require much larger hulls than those associated with the Egadi rams. The Egadi warships best accord with the dimensions and attributes of "threes"; however, the timber dimension evidence indicates smaller overall dimensions for "threes" than has been previously suggested. Possible support for the presence of threes may be found in the account of the aftermath of this battle. Subsequent to the naval engagement, 70 captured Carthaginian warships were reported to have a combined crew of nearly 10,000 men taken as prisoners, which provides an untenable average of *c.*142 men per warship if all captured warships were "fives" (Polyb. 1.61.6-8). With 420 individuals aboard a "five", the expected number of prisoners would be nearly 30,000. A portion of the unaccounted-for Carthaginians from these 70 warships will be the number who died during the conflict, thus not included in the total of prisoners. A second factor in this conspicuously low number may also be that the captured warships included "threes", which had about half the total crew size of a "five". Also in support of "threes" present at the battle of the Egadi Islands is Diodorus 24.11.1 quoting Philinus, a source for Polybius, who notes mixed vessel types (that is, makrais nausi, ploiois, and poreiois, or 'warships', 'merchant ships' and 'transports', a higher number of ship totals, and a larger number of sunken ships for both sides.

This begs the question why "fives" were the only warships in this battle mentioned by Polybius. It is possible that only the "fives" were mentioned as he is stressing the special building project and larger, more prominent ships. Given the success of the "fives" for the Romans and the overall high losses by the Carthaginians, the losses of "threes" may have been less important for the historians to mention. In fact, Polybius (1.63.7-8) stresses the greater importance of these engagements compared to the earlier naval battles of Antigonus, Ptolemy and Demetrius, on the basis that the naval battles of the First Punic War featured a large number of "fives" *versus* the "threes" of the earlier periods.[83]

Iconographic and epigraphic evidence

Like many state-manufactured items requiring a large investment, the Egadi rams display decorative features, albeit to varying degrees. A decorative feature present on all is the stylized shape of their fins. Unlike the cast sword handles on the fin plates of the Athlit and Acqualadroni rams that depict each fin as the blade of a sword, the Egadi fins come together at the fin plates to form a shape akin to a trident (figs. 4-10). Tridents are commonly depicted in Greco-Roman antiquity, usually associated with Poseidon/Neptune. Although less is known of the iconography associated with Punic sea deities, it seems the trident was familiar at Carthage by the 3rd c. B.C. Other molded decorative elements were included in the rams' casting. The sole decorative elements on Egadi 1 are small rosettes cast on its fin plates (fig. 4). Winged Victories are cast on the upper cowl nosings of Egadi 4 and 6 (figs. 7 and 9); both face to their right dressed in an ankle-length gown, and carry a laurel crown in their right hand, with a palm frond in their left. C. Hallett and T. Hölscher note that crowns and palm branches were introduced at Rome for victors in 293 B.C. (see Livy 10.47.3) and the Victory motif on the two rams is similar to that on Roman didrachms minted between 265 and 241 B.C. (Crawford, *RRC* no. 22/1). Hölscher points out the frequency of this motif on 3rd-c. coins of Sicily and S Italy, the geo-political sphere where Rome begins its display of power, in part, by the issue of coinage. A general

82 Casson, ibid. 105-6 n.41, 156, 418, figs. 120-23.

83 We thank W. M. Murray for ideas and discussion.

military context for Victoria in 3rd-c. Rome is given by the temple to Victoria dedicated on the Palatine in 294 by Q. Postumius Megellus to commemorate the victory in the Samnite Wars.[84] The Egadi 7 ram has a warrior head wearing a Montefortino helmet emerging from the upper cowl nosing, and its cheekpieces are identical to those found inside Egadi 6; the warrior head may be Roma personified, Minerva, or simply a soldier (identification is difficult as it appears the face was damaged in a purposeful fashion). Atop the helmet are three feathers attached to a ring sitting on its upper dome, a configuration described by Polybius (6.23.12-13).

The inscriptions on the Egadi rams are a valuable historical resource. A full exploration of the inscriptions and in-depth analyses of letter- and word-forms is slated for a later publication, but the preliminary analysis provides some useful results. Inscriptions were noted on the cowls of rams 1, 3, 4, 6 and 7, all in scripts of the 3rd c. B.C., and read from the starboard side. The Punic inscription on Egadi 3 attests to Carthaginian manufacture. A partial segment of the inscription has been analyzed with two possible translations. The first is: "We pray to Baal that this ram will go into the enemy ship and make a big hole".[85] Subsequently, P. Schmitz, based on extensive comparanda, reads: "*. . . tn̊t k̊ bn̊ bʿlm̊ l hwn spt ršp ẘ h̊mm lʾbn tḥ[t . . .]*", translated as: "... Tanit, for in it are its *officers*. Blow, gales of Reshep! and build the surge/overflowing/wave und[er (?) ...]".[86] This preliminary translation would reflect the Carthaginians invoking the gods in hope of assistance for success, while the references to winds underscore this crucial aspect of sailing for successful warship missions.

The Latin inscriptions on Egadi 1, 4, 6 and 7 attest to Roman manufacture, but they reflect different contexts. The inscription on the cowl nosing of Egadi 1 was engraved in 4 lines after the ram was cast. The first published transcription was: C SESTIO P F / Q SALONIO Q [F] / SEX VIROEṆ[-?--] / PROBAVE[-?--].[87] J. Prag offers an expanded text: C(aios) Sestio(s) P(ublii) f(ilios) / Q(uintos) Salonio(s) Q(uinti) [f(ilios)] / SEX VIROEṆ[-?--] / probave[re]. The text records 6 officials (*sex vir(i)*) overseeing the quality control of the rams' castings. A portion of the inscription is illegible on the right side and *E N* remains enigmatic, so the exact meaning is still uncertain. Prag suggests that the letters following *sex vir(i)* or *sex viro(m)* may be the abbreviated title of the sevirate's function (compare the Gracchan *termini*).[88] In

84 The iconography was reviewed by C. Hallett (Univ. of California at Berkeley) and T. Hölscher (Univ. of Heidelberg). Hallett further observes that the hairstyle appears to be Early Hellenistic (*Melonenfrisur*).

85 An initial reading was provided by G. Garbini (Università di Sapienza, Roma).

86 For "officers" Schmitz notes *bʾlm*. (nom. masc. pl.) can possibly, but less likely, be translated as 'lords/masters'. The semantic uncertainty is whether *bʾl* refers to human military commanders, to citizenry, or to divine beings. The Phoenician word *bʾl* generally means 'owner, master, lord' (*Dictionary of North-West Semitic Inscriptions* 183 *s.v.* bʾl$_1$); in that sense it serves as an epithet of the Storm god also known as Haddad. But the word can also designate human beings who are husbands (ibid. 183 *s.v.* bʾl$_1$), landowners and/or citizens (ibid. 183-84), and a military or naval officer (ibid. 184). The phrase *bʿl m ym*, 'master of the waters of the sea' (*CIS* I 86 B = KAI5 37 B) appears to have been a title of naval command at Kition in the Achaemenid period. We can speculate that the *blm* in this text might also be naval commanders. Another possible word grouping offered by Schmitz would provide "*. . .* tn̊ tk̊bn̊ bʿl m̊l" and translate as "tn May you O Ball extinguish it, opposite …".

87 See Gnoli 2011 for publication; slightly modified transcription here by J. Prag (Univ. of Oxford).

88 Gnoli 2011; Prag points out the missing missing 'f' in line 2 and the incomplete ending of

any event, the forms of the script are consistent with those of the mid-3rd to early 2nd c. B.C. and confirm the ram's manufacture by Rome. This inscription alone cannot be used to support a particular fleet building program or the fleet's construction in 242 for the surprise attack at the Egadi Islands.

Egadi 4 and 6 feature an identical text in their cast inscriptions, which are arranged in two lines on their cowl nosing: M·POPULICIO·L·F·Q·P / C·PAPERIO·TI·F *vac.*, but the names are listed in reverse order on each ram (figs. 7 and 9). The letters Q.P. are aligned with the end of M· POPULICIO· L·F on the top line on Egadi 4, but at the end of both names between the upper and lower lines on Egadi 6. A preliminary reading is: M(arcos) Populicio(s) L(ucii) f(ilios) / C(aios) Paperio(s) Ti(berii) f(ilios) / Q(uaestores) p(robavere). It indicates that the rams are from the same building program and probably celebrate the work of two quaestors in financing the fleet construction.[89] Prag notes that, with little epigraphic evidence for quaestors during the 3rd c., these rams provide the chief positive evidence for the quaestorship at this date and are particularly important from an institutional perspective.

The neatly-engraved inscription on Egadi 7 (fig. 10) reads F̣ QVAISTOR· PROBAVET. The curved but still open P differs from those on Egadi 4 and 6 and is more similar to that on Egadi 1.[90] The AI diphthong in QVAISTOR points to earlier Latin and is plausible for the 3rd c., as are the letter-forms. Here again a quaestor is celebrated prominently on the cowl nosing; his name is lost, but the available space and the presence of *F(ilius)* makes its original presence a certainty.

The different types of inscriptions possibly indicate the rams are from distinct building programs by Rome, but it is not possible to assign them an absolute chronology or to a specific building program. The inscriptions attest different meanings and contexts in their production. The Egadi 1 ram received an inscription after casting, attesting to quality control by a board of six, and it was not featured in a prominent manner. This ram displayed no deities, decoration being limited to simple rosettes on the fin plates. Whereas the inscription on Egadi 1 is wholly bureaucratic in nature, those on Egadi 4, 6, and 7 celebrate the efforts of specific officials, the quaestors, who oversaw fleet financing. Since over the course of the 3rd c. milestones began to record the specific efforts of officials (aediles and consuls);[91] perhaps the quaestors were following a similar pat-

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'*probave*' in line 4. Gnoli considers the form "VIRO" to be erroneous, amending to "VIR<I>". However, Prag points out that "VIRO" at this date is an acceptable abbreviation of the genitive plural (*virom*), which would not be unusual for the name of a college, and that Gnoli's suggestion of EN[BOLUM], based on a single instance in Petronius, is speculative. One possible resolution for SEXVIROEN (which Prag owes to M. H. Crawford) is *sex vir(i) o(peri) e(xigendo) n(avali)*, but clearly other possibilities can be imagined, depending on how many letters may be lost after EN.

89 Reading provided by Prag, who rightly points out that the inscriptions do not require any command functions by the quaestors. A first reading was made by F. Oliveri (Soprintendenza del Mare, Sicily).

90 Reading provided by Prag, who notes that *probavet* is merely an archaic variant for *probavit*, and that the damaged area which precedes the F has space for *c.*8-10 letters, enough for the usual abbreviated *praenomen*, a short *nomen*, and abbreviated patronymic. Prag is reasonably certain from autopsy that the patronymic can be read as *C(aii)*.

91 Later in the 2nd c., coinage increasingly featured the family and names of the moneyers in an effort to increase their prestige and further careers: Crawford 1975, 47-65. Examples of milestones include ones found on the *Via Appia* at Posta di Mesa (*CIL* I^2 21 = *ILLRP* 448) and one at

tern. If so, then Egadi 7, which has the name and office engraved only after casting, may date to a fleet building program earlier than that of Egadi 4 and 6, whose cowl nosings feature prominent quaestors' names in relief letters. If indeed the "threes" are under-reported in Polybius, then several of the Egadi rams with Roman inscriptions may have been under Roman command at this battle. In any account of losses the Carthaginians' were greater, so the greater number of ram finds of Roman manufacture is curious. One possible solution may explain both the high numbers of Roman ram finds and the difference in iconography/inscriptions. According to Polybius, Rome had 5 warship construction phases from 255 until the final battle in 241. Some 140 warships were built in two projects during 255, *c.*110 were built in two phases in 250, and at least 200 were constructed for the battle that took place in 241 B.C. (Polyb. 1.30-61). Although classes are not always specific for these fleet constructions, we know that "threes" and "fives", as well as *lemboi*, were the fundamental classes used in this war (Polyb. 1.20.9, 1.53.9). If we propose a hypothetical seriation of building programs for the rams based on their inscriptions, Egadi 7 could be associated with one of the building programs in 255, while the Egadi 4/6 rams could be part of the fleet construction in 250. Perhaps the Egadi 1 ram was affixed to one of the 200 ships built in 242, as Gnoli suggests.[92] Regardless of the specific building program, the rams 4, 6, and 7 were probably part of the earlier fleet building programs. The Carthaginians had captured over 100 Roman warships during several conflicts in 249 B.C. (Polyb. 1.60.1-2), some or many of which were undoubtedly "threes". An impression is clearly given that the Carthaginians were scrambling to rush a fleet into service in 241 B.C. (Polyb. 1.61.4-6) and consequently the captured Roman ships (built in 255 and 250) formed part of the fleet sent to the Egadi Islands in 241. In this scenario, it is not unthinkable that the Roman iconography of the deity/warrior's face on the Egadi 7 ram was vandalized by its new owners. Since the Carthaginians were forced to rush naval preparations for the relief effort in 241 (Polyb. 1.61.4-5), the lack of decoration and unfinished tool marks on the Carthaginian-manufactured Egadi 3 ram (and possibly Egadi 2 and 5) is also consistent with the story provided to us. Evidently the Carthaginian fleet that appeared off the Egadi Islands in 241 included older Roman-built ships (perhaps up to a quarter of the fleet) along with new warships rushed into service, all carrying the supplies and equipment for the relief mission. These captured warships were older, their hulls in poorer condition, and likely did not fare as well in the conflict. Some of these ships were "threes", and we have located a sector where numerous "threes" sank. This helps explain why the Egadi 4 ram of Roman manufacture was lying atop an amphora with a Punic graffito.

Conclusions

The finds from the Egadi Islands provide archaeological evidence for the key naval battle described by Polybius that ended the First Punic War in 241 B.C., a crushing defeat for the Carthaginians which launched Rome on its path of expansion and empire. It is the sought-after convergence of the archaeological and historical records. The finds represent a new body of evidence for the study of the First Punic War and its naval engagements. Warship rams, helmets and amphoras discovered *in situ* in a defined area attest to the

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Corleone, Sicily (*CIL* I^2 2877 = *ILLRP* 1277), both dating to the 250s B.C.

92 Gnoli 2011. The clear differences in iconography, inscriptions and overall shape, combined with its unknown provenience, make an association of the Egadi 1 ram with the events of the First Punic War somewhat problematic.

location of ship-to-ship conflicts. The rams more than double the corpus of waterline rams that survive from antiquity. This assemblage from the battle landscape is the best data set available for assessing this naval battle, techniques of ram manufacture, warship construction, and the depositional fates of warships of the 3rd c. B.C. Helmets from the battle zone provide some of the earliest contextually-dated evidence for the study of armor in the 3rd c. B.C. Further helmets to be collected and the probable presence of additional armor and weapons in the battle zone should enhance our understanding of military equipment used by central- and western-Mediterranean states at this time. The amphora finds attest to the particular mission of the warships in this conflict, while the entire battle zone gives eloquent testimony to the high stakes and deadly forces involved in ancient naval warfare.

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