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**On the cover**: *An anchor found during the 2005 Bozburun Survey. The anchor was found at the north end of Site TK05-AC. Image: RPM Nautical Foundation*

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# Beyond the Shallows: Shipwreck Discoveries from the 2005 Bozburun Peninsula Survey, Turkey

Jeffrey G. Royal

In 2004, INA President Donny Hamilton approached INA Director George Robb and myself about conducting a survey off the southeastern coast of the Bozburun peninsula (Fig. 1). The project, during July of 2005, was a cooperative effort with the Turkish Ministry of Tourism and Culture represented by Commissioner Gulnaz Savran. I was particularly excited by investigating this area as I participated in the Bozburun shipwreck excavation directed by Fred Hocker from 1995-1998 and knew the ancient settlements of Physkos, Lorima, and Tios were in this area. Over the centuries, this segment of coast was part of an active trade route between these ancient cities as well as Rhodes, Ephesus, and Knidos.

During the summers of 1965, 1967 and 1968, Dr. George Bass led survey expeditions along sections of this shoreline and located a scattered, unidentified wreck in at 100 m of water (Bass, 1976: 29-30). Dr. Bass led subsequent surveys along the southwestern Turkish coast in 1973, 1974, and 1980, where he documented a looted wrecksite near Marmaris and several near-shore dump sites (Bass 1982: 45-7; Rosloff, 1981: 277-81). Also located here is the bay of Serçe Liman where Drs. Bass and van Doorninck, Jr. excavated the 11th-century Byzantine glass wreck from 1977-79, and Cemal Pulak excavated the Hellenistic wreck from 1978-80 (Bass and van Doorninck, 2004; Pulak and Townsend, 1987). More recently in 2004, Jeremy Green and Dr. Faith Hentschel of INA returned to the purported area where a bronze statue was pulled from the sea in 1953 (Green, 2005).

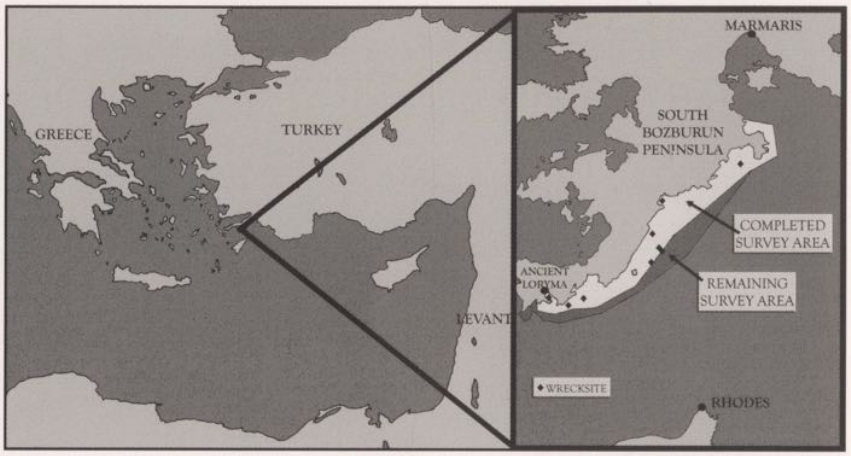



Fig. 1. *Map of survey area with general locations of wrecksites. Map: J. Royal*

Our expedition objectives were to conduct a systematic multibeam survey of the southeastern coast out to a depth of 100 m; and subsequently locate and document any cultural deposit. The survey area extended approximately 37 km from Kadirga Burun at the northeast extreme, just outside Marmaris, to Bozuk Bükü at the peninsula's southwestern end (Fig. 1). By the end of the season, over 120 km$^2$ were surveyed that included the majority of the shoreline out to the 80-m contour.

Multibeam survey was conducted by RPM Nautical Foundation's research vessels the R/V Hercules and R/V Juno that are equipped with remote sensing, verification, and analysis equipment (Fig. 2). A dual-head system for depths up to 100 m is affixed to the R/V Hercules and a single-head system for depths up to 45 m on the R/V Juno. Accordingly, the R/V Juno surveyed from near shore to the 45-meter contour, while the R/V Hercules surveyed between the 40- and 100-meter contours. Based on field experience and the nature of seafloor, the multibeam systems were deemed best for locating cultural resources. Multibeam survey provides highly-detailed three-dimensional data of the seafloor. Hence, positioning information is more precise and it is possible to detect small mounds often missed, as well as exclude many geologic anomalies that

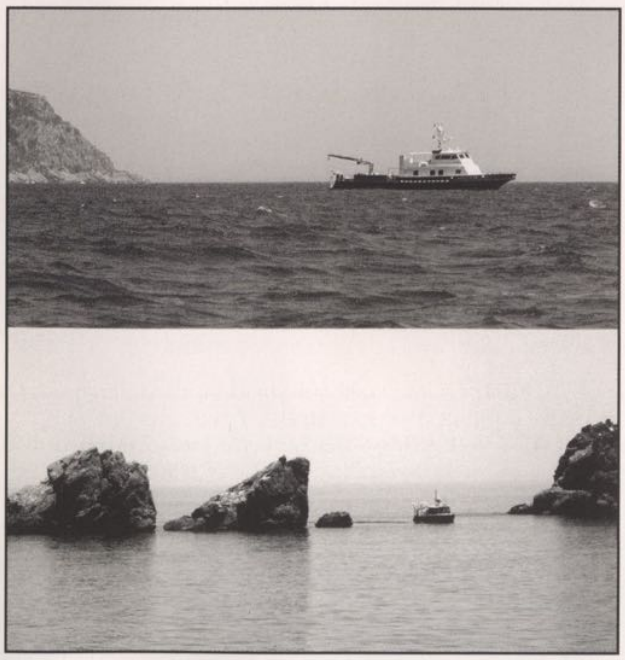


Fig. 2. *R/V Hercules and Juno surveying off the Turkish coast. Photos: RPM Nautical Foundation*

often plague other systems.

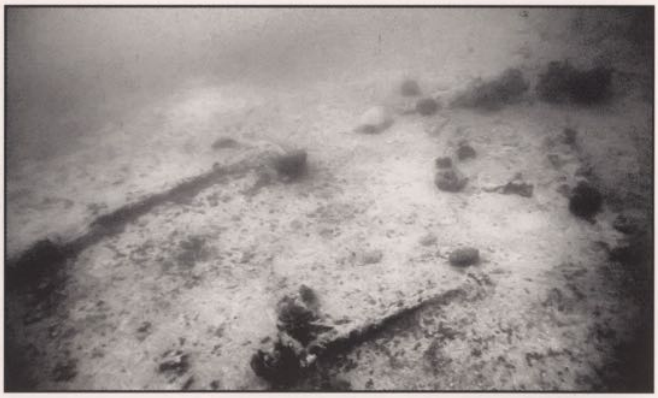
Multibeam data was processed onboard the R/V Hercules and reviewed for potential shipwreck sites, which were then investigated with the remote operated vehicle (ROV). Outfitted with still and video cameras, lights, and sonar, the ROV provided complete image documentation on wrecksites. A laser attached to the ROV provided a photographic scale that assisted in individual object identification and the construction of preliminary site plans.

**Overall Results and Specific Shipwreck Sites**

To date, 77 anomalies were identified in the multibeam data. Of the 75 anomalies beyond diver depth, 29 (39%) were investigated by ROV deployment, and 7 of these 29 (24%) were shipwreck sites. The remaining two anomalies were located by the R/V Juno, sites TK05-AA and TK05-AG, and were clearly discernable as shipwrecks in the multibeam imagery. As these vessels appeared modern, intact, and had little signs of burial, they were designated for diver verification at a later time. Site TK05-AA lies at a depth of 24 m near Kumlu Burun, a narrow passage near the rocks and is probably a sailboat or one of the tourist gulets that operate out of nearby Marmaris. Site TK05-AG also appears to be a modern vessel of around 22 m in length that lies within Bozuk Bükü harbor at a depth of 39 m.

Fig. 3. *Site TK05-AE: note the curled metal sheathing, and the two dots of the laser on the keel. (Photo: RPM Nautical Foundation)*

Fig. 4. *Site TK05-AB: anchors in foreground, large cannon atop ballast in upper right. (Photo: RPM Nautical Foundation)*



*Sites TK05-A east and TK05-AF*

Site TK05-Aeast is a small, wooden vessel located at a depth of 72 m. Its articulated timbers appeared in good condition, nail heads were still visible, and the metal sheathing along its hull curled downwards like a peeled banana (Fig. 3). It is likely of a modern date. Site TK05-AF was certainly a modern vessel resting in 87 m of water, which was likely a small sailboat. There is little degradation to its timbers, and loose debris that surrounds the hull includes a boom and a corroded battery.

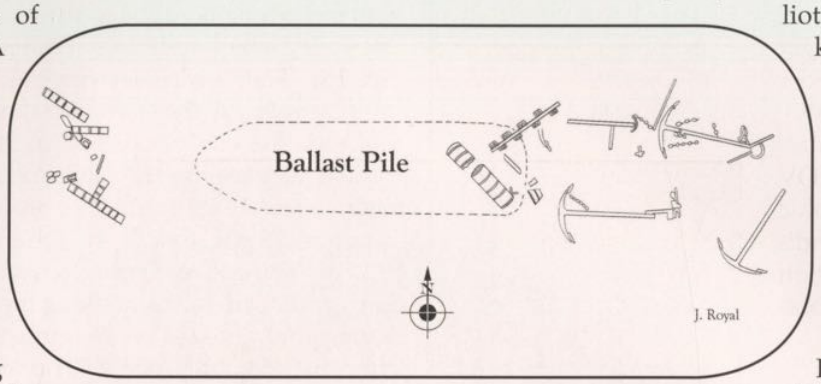
*Site TK05-AB: Galley A Wreck*

July 11, the first day the ROV was made ready to deploy on a target. This anomaly lay about 2 km offshore and appeared in the multibeam image as a small, elongated mound on a flat plain. After the ROV reached the bottom at 75 m, we drove to the target with all eyes glued to video screens on Hercules. A bump in the distance grew and our screens were filled with the image of large anchors.

As we explored the area, we found a relatively undisturbed wrecksite comprised of anchors, armament, and a ballast pile aligned east-west (Figs. 4 and 5). This roughly 16 x 2.5-meter site reaches 1 m high where a gun sits atop the ballast pile that marks the center of the site; four large anchors sit to its east and several pieces of armament to its west. All four anchors are the same type and have the same dimensions, with two-meter long rectangular shafts (Fig. 6). The anchors' arms are a 0.5 m in length that end with triangular flukes, and join the shafts at a slightly curved angle. One anchor has its large ring protruding from the sand, and two anchors have chain comprised of large, rounded links visibly wrapped around them. The four anchors are lying in pairs, aligned end to end, with the axis of each pair converging on the site's center line, which suggests the shape of a vessel's extremity. Anchors were traditionally stowed at the bow of vessels. The anchors' positions indicate the vessel likely sank with them in their stowed positions.

The half-meter high ballast pile has clearly defined edges that extend about 9 x 2.5 m. Smooth,

light-colored stones on its surface range from pebble to fist-sized. The pile tapers at its western end, which mimics the interior shape of a ship's lower hull. A close examination of images revealed no cultural material within the ballast.




The remains of at least three guns are present, all of wrought-iron construction with reinforcement bands along their length. One nearly intact gun is centered atop the eastern end of the ballast pile, and has the largest diameter of the three. Adjacent to one end of the gun sits an apparent breechblock. At least two smaller guns are located approximately 5 m west of the ballast pile that are undoubtedly swivel guns (Fig. 7). These guns have a small, consistent diameter relative to their circa two-meter length and a large reinforcement band at the muzzle. Located nearby are two small cylindrical objects, one of which has a shape consistent with a swivel gun's breechblock. Also, present is a concreted bar and loop on one swivel gun that is probably the stand on which it was originally mounted on the vessel. A long pole-shaped object between the ballast pile and anchors is about 1.5 m in length, and possesses 8-10 loops running along its length on opposing sides (Fig. 4). With a far smaller diameter than any of the guns and no reinforcement bands, it is unlikely armament, rather perhaps part of the vessel's rigging or a battering ram.

This site's dimensions indicate a small, narrow vessel such as a galley. Based on the single cannon at the bow and two swivel guns further aft, this was probably a small rowed war galley such as an Italian fustas or galliot, or a Turkish firkate or kalite. Both the fustas and firkate had a single large center-line cannon, several swivel guns, and probably carried a single lateen rig (Gardner 1995: 142-62; Konstam 2002: 21-3; Alertz 1995: 142-62; Güleryüz 2004: 29, Fig. III-C; Pulak, 2005). Although it is unclear if there are other confirmed archaeological example of these galleys, historical data indicates they were circa 20-28 x 2.5-3.5 m in size, undecked, and had 10-17 banks of oars per side with two men operating each oar (Konstam 2002: 21-3; Güleryüz 2004: 29; Pulak, 2005). The galliot was outfitted, rigged, and operated similar to the fustas, but was somewhat larger at around 27-28 x 3-3.5 m and 18 oars per side rowed by two men (Konstam 2002: 21-3). A Turkish kalite was analogous to a galliot with 19 – 24 banks of oars (Güleryüz 2004: 29; Pulak, 2005).

These galley types were designed for speed and maneuverability as their greatest tactical advantages. The large center gun was their primary armament, while swivel guns were placed at the bow or along the central gangway to provide supporting fire. Hence, the position of the swivel guns on this site probably mark an area forward of the stern, and suggests that this vessel was at least 16 m in length. The lengths of a galliot and kalite are probably greater than this site's dimensions would initially indicate, therefore, the more likely identification for

Fig. 5. (above). *Site TK05-AB: preliminary site plan; not to scale. Map: J. Royal*
Fig. 6. (lower left). *Site TK05-AB: one of the anchors with its chain. Photo: RPM Nautical Foundation*
Fig. 7. (lower right). *Site TK05-AB: southernmost gun at the western portion of site, note the bore of the swivel gun. Photo: RPM Nautical Foundation*

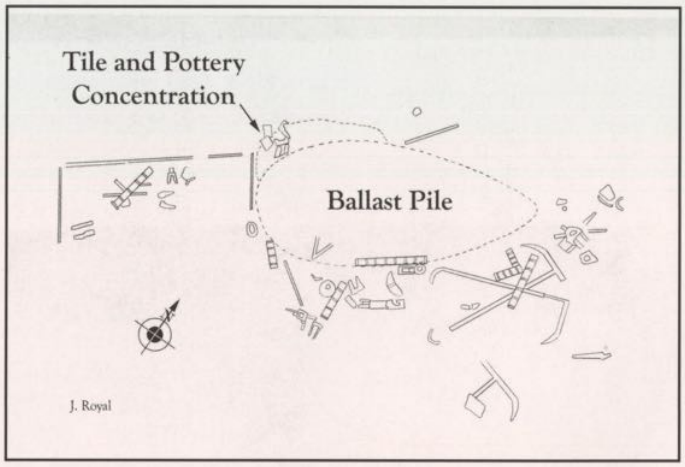



Fig 8. *Site TK05-AH: preliminary site plan; not to scale. Map: J. Royal*

this site is that of a fustas or firkate.

Given that wrought-iron guns were used on ships from the mid 15th - 16th century AD, and that larger galleys were outfitted before smaller ones, the earliest date for the Galley A wrecksite is likely the last quarter of the 15th century. Although wrought-iron guns continued in use on vessels through the 16th century, and later to a lesser extent, bronze guns replaced them at a rapid rate during the early 16th century. As it was increasingly rare to find wrought-iron guns after circa 1530 on galleys in the Mediterranean, the latest operational date for the Galley A wrecksite is approximately the second quarter of the 16th century. Furthermore, the anchors' shapes match as those from other 16th-century wrecks and is also noted in pictorial evidence dating to the late 15th century, where they are stowed at the bow.

The Galley A wreck was probably a fustas or firkate that operated around AD 1475-1550. Small galleys such as these were commonly used in the eastern Mediterranean throughout this period for raiding, patrols, and quick troop delivery and were not typically used in fleet engagements. Although it is not possible at this stage to assign a particular cultural identity to this galley the light armament on the galley suggests one associated with either the Italian city-states, Ottomans, or Knights of St. John who operated out of nearby Rhodes and for awhile in Bodrum.

*Site TK05-AH: Armed Nave Wreck*

An anomaly about 2 km offshore yielded a very interesting wrecksite in 81 m of water. The site covers an area approximately 10 x 4 m and is dominated by a central ballast pile that measures about 6 x 2.5 m (Fig. 8). Notable artifacts on this site were wrought-iron guns and anchors, as well as pottery, large tiles, groups of iron concretions, and remains of the ship's hull.

Three anchors and two rings protruding from the sand are located at the east end of the site, the presumed bow. Two of the anchors lie crossed one over the other (Fig. 9), with the third nearby. A ring on one of the anchors is identical to the two rings protruding from the sand, which indicates there are other anchors buried nearby. The two nearly complete anchors are around 2 m in length. At least two anchor types are present, the rounded 'lunette' shape and a cruciform example that is similar to those on the Galley A site. It appears the anchors were either on deck or stowed on the vessel's bow quarter when it sank.

The half-meter high ovoid ballast pile narrows at both ends and forms a shape reminiscent of the vessel's lower hold. Stones on its surface are smooth and range from fist to cobble size with gravel mixed among them. The ballast pile is littered with ceramic sherds and concretions with a concentration located in the southwestern sector. This concentration of large tile fragments, a concretion that may be the oven, and portions of flat-bottom ceramics (the presumed port-aft section) may indicate the ship's galley. The majority of ceramic sherds on and outside the ballast pile are body sherds of containers with flat-bottoms with small, or no, handles.

There are indications of at least four wrought-iron swivel guns of similar dimensions located around the site. Sections of one gun are lying atop and beside the crossed anchors and together are 1 – 1.5 m in length and have a relatively small diameter (Fig. 10). Additionally, fragments of apparent breechblocks and mounting assemblies were located nearby. A particularly well-preserved section of a gun is lying at the western end of the site, presumably the stern (Fig. 10). This one-meter long piece has a flared end and is clearly analogous to the swivel guns found on the Galley A wrecksite.

Fig. 9. *Site TK05-AH: crossed anchors with gun sections lying atop them. Photo: RPM Nautical Foundation*

Also at the western end of the site are hull timbers protruding from the sand and numerous scattered wood fragments (Fig. 10). The top of a strake is visible running northwest of the gun, and extends at least 3 m to the northern edge of the ballast pile. Two other exposed timbers lie perpendicular to this strake run; one marking the west end of the ballast pile and another marking the west end of the site.

Based on the armament, guns, and ceramics, it is clear the vessel is of a similar date to the Galley A wreck; however, this site's rounded shape indicates a merchant vessel. Historical records indicate that the length-to-beam coefficients of merchant ships were typically about 3:1 for Venetian merchantmen (or 'nave') of the mid 16th century, as well as Spanish merchantmen of the later 16th century. This ratio fits well with the Armed Nave wreck-site. The high presence of ceramic fragments and possible galley remains are also consistent with the remains of a merchantman. Based on the ballast pile, timber remains, and artifact distributions, the size of the vessel is estimated to have been 13-16 x 4-5 m; again consistent with a Renaissance merchantman.

Fig. 10. *Site TK05-AH: gun at presumed aft portion of site, note strake remains at top of photo. Photo: RPM Nautical Foundation*

As discussed with the Galley A wrecksite, wrought-iron guns were used in the mid 15th – 16th century AD. Armament on sailed merchantmen was necessary during the Renaissance due to conflicts between the various Italian states, Turks, and Barbary pirates. Furthermore, developments in rigging and naval armament by the mid-15th century made the smaller sailed merchantmen more cost effective to operate than larger merchant galleys that required vast crews. Armed merchantmen appear to have become common with the Venetians, Genoese, and Ottomans by around 1500 AD, typically by mounting small arms such as swivel guns. The wrought-iron armament, along with the anchor types indicate a date for the Armed Nave wreck between the late 15th to the late 16th century AD (AD 1475-1575).

**Discussion of the Galley A and Armed Nave Wrecks**

Given that two of the five pre-modern wrecks were from the Renaissance era, some comments about their historical context are warranted. With the conquest of western Anatolia during the later 14th century, Turkish forces gained coastal Aegean bases for launching seaborne attacks against the Italian city states, as well as raiding shore installations. The fall of Constantinople to the Ottomans in 1453 further strengthened Turkish maritime capabilities, and was perceived as serious by the West. Consequently, the Knights Hospitallers (Knights of St. John) moved their base to Rhodes in order to better check the Turks. Combined with forays by Barbary pirates, as well as the naval threat of the Mamluk dynasty in Egypt, the waters around the Bozburun peninsula were particularly perilous for maritime ventures. Moreover, overseas trade ventures were as vulnerable to attacks from one another as they were to Barbary pirates. As a result, the Venetians were among the first to arm their merchantmen with swivel guns to offset the threats. In addition to the threats of piracy, raids, and rival encounters at sea, there were three major naval operations during this period. Each operation targeted Rhodes to dislodge the Knights Hospitaller. The first two assaults, in 1444 by Mamluk forces and in 1480 by Ottoman forces, were repulsed by the resilient Hospitallers. However, the third attempt in 1523 by an overwhelming Ottoman force wrenched the city from the Knight's control and sent them in search of a new base of operations.

Considering the hostilities around the Bozburun peninsula area in this area, it is not surprising that two vessels from this period were discovered. The Galley A and Armed Nave wrecks are situated between the former Ottoman emirate of Menteshe and the Hospitaller fortress city of Rhodes. This stretch of water also lies along the maritime pilgrim path to the Levant and trade routes used by the Genoese, Venetians, and Ottomans. Smaller galleys, such as the fustas or firkate, were used to escort merchantmen (some armed) through dangerous waters, delivered Ottoman forces during the siege of Rhodes, and served as part of Hospitallar squadrons patrolling for pirate or raiding activity. Although as association with a specific cultural group or historical event cannot be made now, when placed within the historical context of the area, these two wrecksites provide tantalizing prospects for the examination of events known primarily from written sources.

*Site TK05-AC: Çomlek Burun Wreck*

Site TK05-AC was close to shore, some 150 m from the cliff face near the promontory of Çomlek Burun. The wreck, a mound of roughly 60 amphoras with an anchor at one end, lies on a sandy bottom at 65 m of depth (Fig. 11). Considering there are numerous amphoras visibly buried in the sand, there are at least three layers of amphoras that cover an area approximately 10 x 3 m. Proximity to the shoreline protected this wrecksite from dragnets and kept amphoras mostly intact (Fig. 12). There is evidence of two forms of a single type; both forms have generally small, rounded bodies that taper towards their bases. However, one form has a shorter neck and a slightly more rounded body (Fig. 13). The closest parallel for these amphoras are the small pyriform amphoras found on the 11th-century Serçe Limani wrecksite located around 15 km to the southwest and excavated by Drs. Bass and van Doorninck, Jr. in the 1970's.

Fig. 11. *Site TK05-AC: layers of amphoras in an oblong mound. Photo: RPM Nautical Foundation*

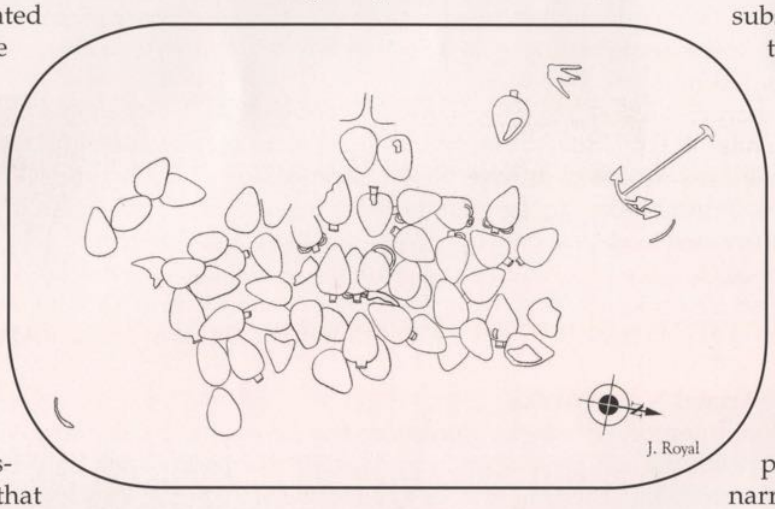



Fig. 12. (Center) *Site TK05-AC: preliminary site plan; not to scale. Map: J. Royal*

A grapnel anchor situated at the northern end of the site is approximately 1.5 m in length, with large triangular flukes and a crescent-shaped crown that curves downward towards its arms (cover photo of this Quarterly). The grapnel anchor provides some general dating parameters for the site as these large-fluked types became common in the 12th century AD and are featured in depictions through the 15th century AD. Considering both the amphora and anchor evidence, the provisional operational date for the small merchant vessel is the late 11th – 12th century AD.

This provisional operational period for the Çomlek Burun wreck encompasses the first three crusades (AD 1095-1192) and the steady rise in Christian pilgrimage traffic from the west to the Levant. Increased travel, combined with the general growth in the demand for imported goods, spurred overseas trade and military ventures in the eastern Mediterranean during this period. The discovery of the Çomlek Burun wreck, in relation to the Serçe Limani wreck, helps to substantiate the importance of the trade route along the southern Bozburun peninsula during this historically significant period.

*Site TK05-AD: Late-Antiquity Anchor Wreck*

Investigation of a small anomaly 2 km off shore yielded an amphora deposit with a collection of anchors at 85 m of depth (Fig. 14). The amphora deposit forms an approximately 9 x 3-meter oval that narrows at both ends and suggests the shape of a merchantman's hold. Apparently, the site has been dragged as it has very little relief off the seafloor. Two deposits of anchors are located approximately 4 m to the west and northwest of the amphora deposit (Fig. 16).

Initial study of the amphoras indicates a minimum of three types. One large type (Type I) is around 50 cm in length, and has a rather bulbous body, thick handles,

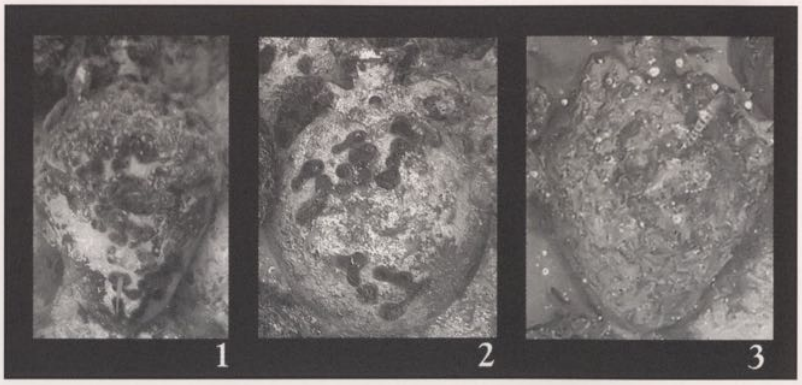



Fig. 13. *Site TK05-AC: amphora examples. Photo: RPM Nautical Foundation*

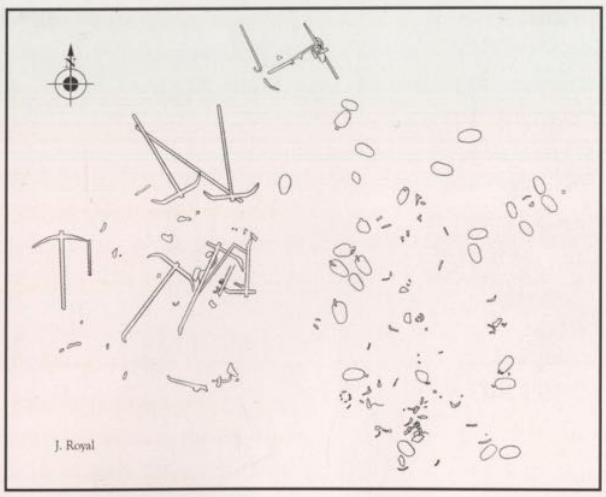



Fig. 14. *Site TK05-AD: preliminary site plan; not to scale. Map: J. Royal*

and ridges along the body (Type I; Figs. 15-1, 2). Another large type (Type II) is around 10 cm longer and more bulbous so that it has a 'beehive' shape; it also has ridges along the body (Type II; Fig. 15-3, 4). A smaller variety (Type III) is only about 40 cm long has short strap handles and has a pyriform body that tapers to a foot at its base (Type III; Fig. 15-5). Type 1 amphoras from the wreck are a well-known type of Late Roman amphora used to ship both olive oil and wine that date to the late 6th – beginning of 7th century AD (AD 575 – 625). Notably, they are similar to the Type IV amphoras found on the Yassıada wreck dated to the early 7th century AD. Precise archaeological equivalents for Type 2 amphoras have proved elusive. The best comparison is an amphora on the Great Palace mosaic from Istanbul dated to the 6th century AD. The single example of the Type 3 amphora matches a type of Late Roman amphora at the end of its development during the 6th century AD. Taken as a whole, the amphoras suggest a date in the 6th century AD.

There are at least 9, and possibly 11, anchors located in the two deposits with amphora fragments scattered among them (Fig. 16). The numerous concentrated anchors suggest they were in their stowed positions when the vessel sank. Seven anchors have clearly discernable arms, six of which are of a cruciform shape that upturn at their ends. A single anchor has lunette-shaped arms that curves gently from the shaft joint. Anchor stocks were not observed on most of the anchors; however, one example has a two-meter stock and ring attached to the top of its shaft.

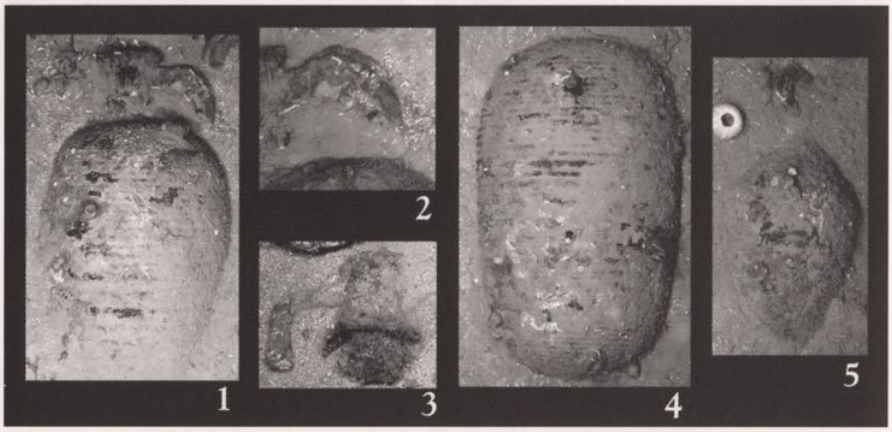



Fig. 15. *Site TK05-AD: amphora examples. Photo: RPM Nautical Foundation*

Although cruciform anchor styles were used in the Mediterranean from the 4th – 10th centuries AD, the lunette-shaped anchor was utilized primarily during the early Roman Imperial period. Thus, the presence of both types suggests a date between the 4th and 7th century AD. Similar cruciform anchors were found on the Dramont F wreck from France dated to ca AD 400, and on the 7th-century AD Yassıada shipwreck from Turkey. Despite this similarity in arm shape, the anchors from the Dramont F and Yassıada wrecks differ in their relationship of shaft to arm lengths. Anchors from the Dramont F wreck have relatively short arms relative to their total length, while the anchors from the Yassıada vessel have relatively longer arms. The anchors from the Late-Antiquity Anchor wreck have an average shaft-to-arm coefficient value almost identical to those from the Yassıada vessel. Hence, the date suggested by the anchors is a closer to the 7th century AD. Together, the amphora and anchor evidence suggest an operational date for this wrecksite in the 6th century AD (AD 500 – 600). An estimate of vessel size may be deduced from the number of anchors present. Only four anchors, all smaller than those

Fig. 16. *Site TK05-AD: group of anchors near amphora deposit, note the lunette-shaped anchor to left; second group beginning at top of photo. Photo: RPM Nautical Foundation*

on TK05-AD, were located on the Dramont F wrecksite; a small cargo carrier of about 10-12 m in length. The 9 – 11 anchors found on the Late-Antiquity Anchor wreck corresponds with the 11 anchors found on the 7th-century AD Yassıada wreck that is estimated to have been 21.5 x 5.5 m.

Type I amphoras were produced in the eastern Mediterranean, namely in Syria, Cyprus, Rhodes, along the southwestern Anatolian coast, as well as areas of the west Black Sea. Possible origins for the small Type III amphoras include those of Type I as well as the Aegean. Emperor Justinian's reconquest campaigns dominated the 6th-century Mediterranean world in that they restructured trade patterns, altered the political landscape, and produced large building campaigns. The conquest of Carthage by Justinian's forces in AD 533 and campaigns in the western Mediterranean resulted in a general movement of goods from east to west. With at least three types of eastern Late Roman amphoras comprising the cargo of the Late-Antiquity Amphora wreck, this site provides an excellent prospect for the study of this poorly understood era.

Fig. 17. *Site TK05-AI: site photo showing oval shape. Photo: RPM Nautical Foundation*

Fig. 18. *Site TK05-AI: close-up of deposit, note the heavy growth on most of the amphoras that served as homes for many eels. Photo: RPM Nautical Foundation*

*Site TK05-AI: Julio-Claudian 1 Wreck*

Near the Armed Nave wrecksite was an anomaly at 83 m of depth. As the ROV approached this anomaly, we were initially disheartened to see a rock outcrop with a single stray amphora lying atop it. As the image grew larger one, then another, amphora came into view; suddenly a chorus of "they are all amphoras". The large amphora mound appeared to be relatively undisturbed and formed a nearly perfect oval of approximately 15 x 5 m (Fig. 17).

The tremendous amount of marine growth made the production of a site plan from photography unworkable; however, there are at least three types of Rhodian amphoras evident (Fig. 18). These are the large and small elongated body types (Types I and II; Figs. 19-1 and 2), as well as the more bulbous body variety (Type III; Figs. 19-3). Each type has the characteristic curved handles with a sharp peak at their apex, long necks, rounded rims, and a long foot at their base (Fig. 19). Such amphoras typically carried wine, but also were used for shipping fruits. The two elongated types are analogous to many examples of Rhodian amphoras found throughout the Mediterranean and dated to the 1st century BC – early 2nd century AD, while the bulbous Type III is typically dated to the late 1st century BC. Based on the presence of the three amphora types, the operational date for this vessel is 50 BC – AD 50.

The cargo suggests that this merchantman originated in Rhodes, about 20 km south-southeast of the wrecksite (Fig. 1). Ancient Rhodes made great strides on the political and commercial landscapes when it sided with Rome during the First Mithridatic War in the early 1st century BC. Shortly thereafter Pompey the Great spared Rhodes from the revocation of tribute immunities. Despite the temporary rise in piracy at the fall of the Republic, the stability during the Julio-Claudian era nurtured growth in Mediterranean trade. Demand for goods in Rome itself was substantial; an estimated 150-300,000 tons of grain and equivalent amounts of wine and oil were imported each year. This heavy demand led to over-laden ships taking to sea, and one ap-

proaching the Turkish coast met an untimely end. Further study of this wrecksite can shed new light on this complex and vibrant period of Roman economic history.

**Further Study: The 2006 Expedition**

During the 2006 season, the remaining anomalies along the Bozburun peninsula will be investigated along with any newly discovered anomalies in the data. Subsequent to the completion of the southeastern Bozburun target verification, a multibeam survey of the Bodrum approaches will commence. Indications are that equally as exciting finds will be made.

*-jroyal@rpmnautical.org*

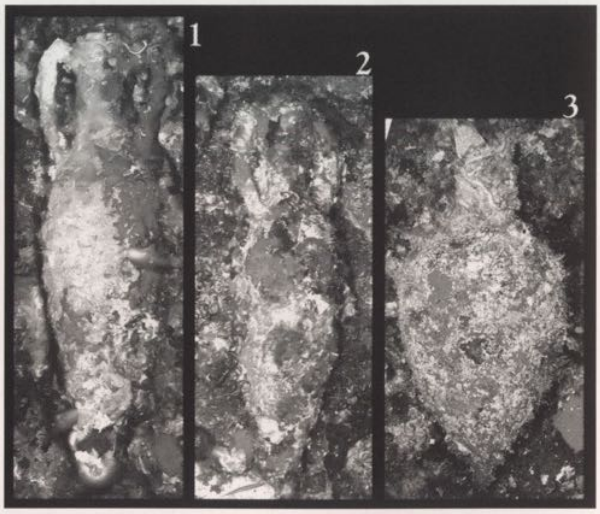



Fig. 19. *Site TK05-AI: amphora examples. Photo: RPM Nautical Foundation*

*Acknowledgments*: On behalf of RPM Nautical Foundation and the Institute for Nautical Archaeology, the author would like to thank the Turkish Ministry of Culture, Navy, and Coast Guard for their permission and assistance with this project. Also, the efforts of Tufan Turanli of INA Bodrum and members of the INA administrative staff are notably appreciated. Particular thanks to Jeremy Green and Faith Hentschel for providing information about the 2004 survey and to Don Rosencrantz for his sharing of information gleaned during the 1968 investigation. Much appreciation is owed to the following whose correspondence greatly furthered the analysis of the wrecksites: George Bass, Marco D'Agostino, Joann Freed, Stefano Medas, Cemal Pulak, and Fred van Doorninck, Jr.

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# Reconstructing Vessels: From Two-Dimensional Drawings to Three-Dimensional Models

Alexis Catsambis

One of the unique objectives of the Nautical Archaeology Program at Texas A&M University is to enable its students to reconstruct an ancient or historical vessel based on evidence obtained from archaeological, textual or iconographical contexts. For this purpose, the J. Richard Steffy Ship Reconstruction Laboratory was set up in 1976 and students have since been trained in the necessary skills. Recently, new tools have emerged that allow students to take their proficiency in research, interpretation, and drafting into the realm of three-dimensional modeling. In a further application, even the sailing capabilities of these reconstructions may be to the tested in a virtual environment using software that is designed for today's naval architects.

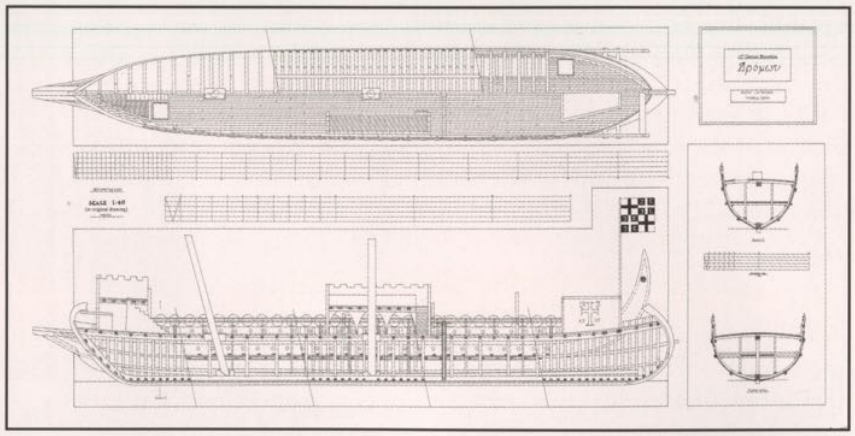


Fig. 1. *Reconsctruction drawing of 12th-century Byzantine Dromon. Image: Alexis Catsambis*

This particular reconstruction involves the Byzantine Dromon ('runner'), which from at least the 6th to the 12th centuries A.D. served as the pride of the Byzantine navy. Although roughly eighty Byzantine shipwrecks have been reported in the archaeological literature, no archaeological evidence for a Byzantine warship has yet been recovered (van Doorninck 2002:899). This source of information is therefore not particularly helpful and it is only through indirect evidence, i.e. the construction of remains of merchant vessels (such as the 7th-century A.D. Yassi Ada wreck, the Bozburun wreck, and the Serçe Limani wreck) that this category can prove useful. Christides believes that the construction and functions of warships were closely related to those of merchantmen (Christides 1988:317). Although this statement may prove to be true, for the moment, we simply cannot establish its veracity, as we cannot compare the remains of a warship with those of a merchantman. The reconstruction of a dromon must thus mostly depend on textual and iconographical evidence.

The earliest specific mention of the word dromon (from δραμεῖν = to run, to move quickly (Christides 1995:116)) in our literary sources is in the 5th-century papyrus charters from Ravenna, where it is used to denote small craft operating at the mouth of the Po River (Anderson 1962:36). Beginning in the 6th century onwards, the sources which refer to this ship type proliferate rapidly and come to include John the Lydian's On the Magistracis, Cassiodorus' Letter Collection, John Malalas' Encyclion, a rescript of Emperor Justinian (A.D. 534) and the Strategicon of Maurice (Pryor 1995:101). The first source to give any detail on the type of ship under discussion is the Byzantine courtier and historian Procopius of Caesaria, who accompanied General Belisarios as his secretary on the Byzantine expedition to Vandal Africa in A.D. 533 (Pryor 1995:101). Later on, in A.D. 706-709, local officials of Umayyad Egypt used Byzantine terminology when describing Muslim ships, including the word dromon (Makrypoulias 2002:180). At this point, however, there is unfortunately a span of two centuries until the next surviving literary sources. When they do reappear in the tenth century, they come in a greater quantity than at any previous time. Early in this century, the chronicle of Ioannis Kameniates recounts the sack of Thessaloniki by the Arab fleet under Leo of Tripolis (A.D. 904) (Livadas 1995:283). The most valuable collection of information is contained in a number of military treatises known as Τακτικά-Στρατηγικά (Kolias 1984:129). Among the most important of these is the Naumachica (Περί θαλασσομαχίας) of Emperor Leo VI, probably dated to A.D. 905-6, and the anonymous Παρά Βασιλείον Πατρίκιου και Παρακοιμωμένου (henceforth Anonymous Treatise), which Dain dates to the years immediately following the Cretan expedition of 960-1 (Dolley 1948:47). Later in the tenth century, Nikephoros Ouranos' Tactica also offers a reference, although the work is mostly a close paraphrasing of Leo's text (Pryor 1995:102). In addition, this century affords us other texts which provide less direct evidence as to the form and function of the dromon. Most important of these are three contemporary inventories, unfortunately very fragmentary, related to naval operations undertaken by Leo VI, Romanus Lecapenus, and Constantine Porphyrogenitus (Dolley 1948:47). Constantine VII (Porphyrogenitus) left behind, among other texts, the Book of Ceremonies, detailing descriptions of armaments of warships and of naval tactics (Lev 1984:246). Of less use are numerous allusions to matters of naval importance in documents of contemporary or near contemporary historians and chroniclers. The last

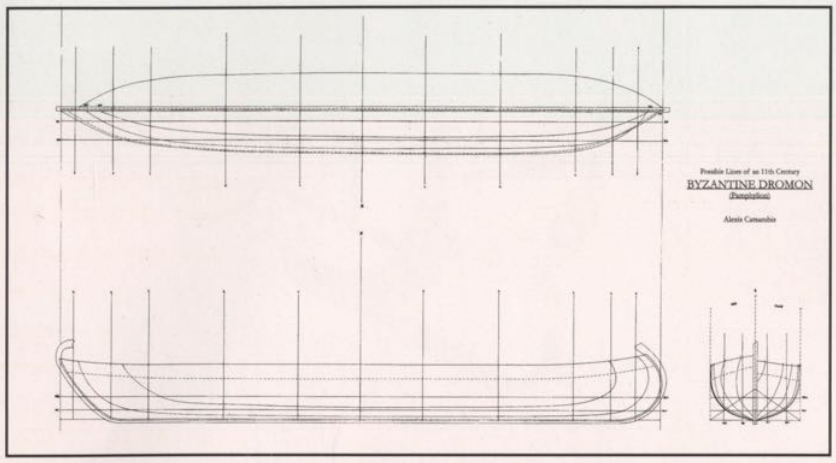



Fig. 2. *Possible lines of a 12th-century Byzantine Dromon. Image: Alexis Catsambis*

literary sources that can be utilized belong to writers of later date such as Anna Comnena and Theodore Prodromus, who allude to practices that must have been widespread during the previous two or three centuries (Dolley 1948:47). Although the dromon was replaced by the galley during the thirteenth century, brief references to the dromon persisted in narrative and documentary sources until the Middle Ages (Dotson 1969:109).

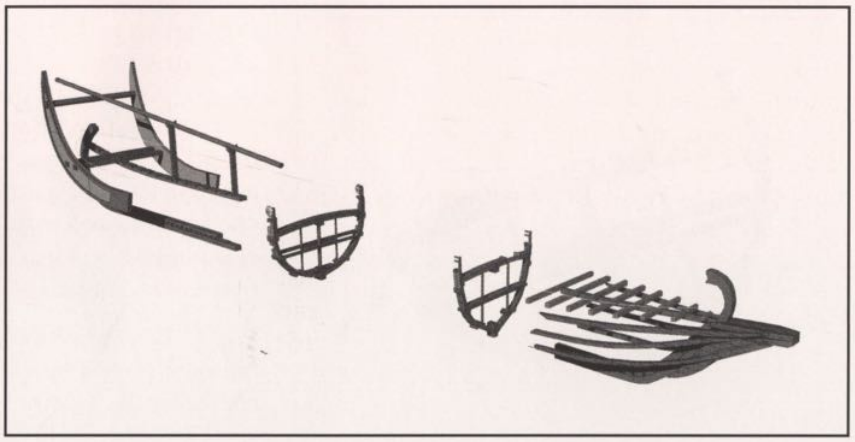
It is important to remember that necessary caution must be applied when attempting to retrieve information from these texts. Misinterpretations and errors within text may have occurred from the original sources of the authors, their misinterpretation of the information conveyed to them, and/or throughout the texts' repeated copying by individuals unfamiliar with the material. At the same time, texts may have been written with purposeful conservatism or even intentional misinformation. After all, revealing information to foreigners was a serious crime and considered a capital offence (Christides 2002: 92). Leo VI, our most valuable source, exercised extreme caution in disclosing confidential information for fear that the enemy may get a hold of his text. Indeed, his fears proved valid as his whole work was translated into Arabic, fragments which have been preserved in the 13th-century Arab author Ibn-al Manqalī (Christides 1988:322). Hence, not only is the evidence that has survived possibly compromised, but some of it is intentionally unclear.

Turning to the final source of evidence, iconography, one encounters a similar situation. The earliest surviving depiction of a dromon is an illustration from the fifth-century 'Roman' manuscript of the Aeneid of Vergil, originating in a metropolitan centre of the West. It is followed shortly thereafter by miniatures of many dromons in the early sixth-century Ambrosiana manuscript illustration of the Iliad of Homer, which originated in Constantinople (Pryor 1995:102). Subsequently, there is a questionable graffito of a Byzantine warship from Malaga that may date to the end of the seventh century. Unfortunately, from this point on to the tenth or eleventh centuries, there is a great lack of iconographical evidence. In the later period, however, numerous depictions begin to appear. Of particular importance is the Skylitzes Matritensis dating to the second half of 11th century.

One must exercise even more caution with the iconography, as not only were most of the depictions drawn by non-naval experts, they are also not particularly realistic, out of proportion, and, once more, often purposefully concealed details pertaining to the construction of the vessel. To offer an example, according to Pryor (1995:106), not one of the illustrations we are aware of shows more than a single mast.

Intrinsically, our evidence poses difficulties. Where did the information originate from? How was it conveyed to the author or artist? Is the author or artist someone knowledgeable in naval matters? Who is the intended audience and how much information is purposefully concealed or mis-represented? Texts or images copied repeatedly may in the course of this process develop differences with the original work. Although these differences may be minor, serious confusion may arise. For example, in the Anonymous Treatise text, a structure similar to a forecastle is reported to be found amidships on larger dromons (Dolley 1948: 51). There is some con-

Fig. 3. *Three-dimensional reconstruction of key structural components created in Rhino®. Note: Proportions in three-dimensional composite reconstructions have been slightly altered for the benefit of presentation. Image: Alexis Catsambis*



troversy, however, on where this structure was actually located as the text includes the phrase 'περί τό μέσον του καταρτίου', meaning 'half-way around the mast.' Placing the xylokastron half-way up the mast does not make good structural sense. In addition, a thirteenth-century text by Ibn al-Manqalī refers to an Arabic translation of Leo IV's Naumachica and translates this passage as 'in every ship there is a forecastle by the mast' (Livadas 1995: 285). Thus, a possible revised translation reads περί τό μέσον κατάρτιον, or, 'around the middle mast' (Dolley 1948:51). Through careful interpretation and analysis of the evidence we are, nevertheless, able to attempt a reconstruction of both the vessel's lines and of its structural components (Figs. 1-2).

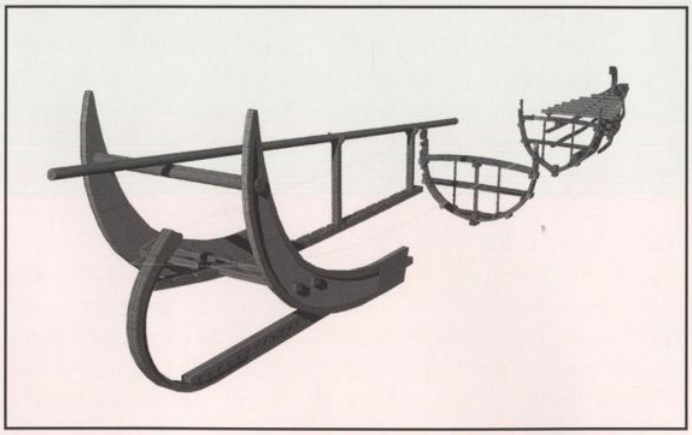


Fig. 4. *Reconstruction view from the stern. Note: Proportions in three-dimensional composite reconstructions have been slightly altered for the benefit of presentation. Image: Alexis Catsambis*

The lines of a wooden vessel are as individual as a fingerprint. Lines or proportions may be recorded in order to 're-create' a successful design, but during construction each vessel will adopt its own particular characteristics. In the case where archaeological evidence is present, the reconstruction lines will attempt to accurately represent the individual vessel. In a case such as ours, where one is not studying a particular vessel, but a vessel type, the lines are made to represent an idealized archetype.

The main elements one needs to consider when reconstructing lines are the length, beam, height and arrangement of the main structural components of the vessel, as well as its function and environment. For the Dromon, we can safely assume that the hull of a galley was long and of shallow draught, with a low freeboard, indispensable in order for the oars to enter the water at the lowest possible angle (Babuin 2002:30). To offer an example of how dimensions are established, the length of the dromon reconstruction is based on the fact that the lower level of rowers is seated on twenty five thwarts. Each thwart, which for practical reasons needs to be at least 20cm wide, also needs to be approximately 90cm-100cm apart from each other in order to allow for effective rowing. It is here where indirect evidence from archaeology can offer valuable suggestions. By this time period shipwrights are beginning to use measurements and proportions to predetermine the shape and size of their vessels. In the Serce Limani vessel, researchers have identified a unit of measurement of approximately 32cm to represent the Interestingly enough, three Byzantine feet are approximately 96cm, a very reasonable number for an interscallum, or distance between thwarts. At the same time, two-thirds of a foot represents a good width for a thwart. Multiplying these dimensions out by twenty-five thwarts, and adding a further quarter of that length for the bow and stern, one gets a number very close to a round 120 Byzantine feet, or 38.4m. This length corresponds well with what we know from previous and later warships and with all the other information we can interpolate from the available evidence. Thus the various elements are identified and then pieced together, always making sure that the lines are fine and correspond with one another.

The next step is the reconstruction of the actual major structural components of the vessel. Although illustrations can provide us with general concepts and perhaps locations of components, the majority of the evidence comes from a textual context, as well as what allows for good structural sense. Measurements and proportions are key as all components need to be interrelated. Naturally the more information that can be generated, the more the detail that can be applied to the reconstruction.

Once both the lines of the vessel and the reconstruction of its structural components are complete, a new factor can be introduced into the equation. Through digitizing the lines and the reconstruction drawings into a three-dimensional modeling program such as Rhinoceros®, one can then begin to reconstruct the various components in virtual space (Figs. 3-5). Elements such as the appropriate size, shape and curvature of components come to life in a way

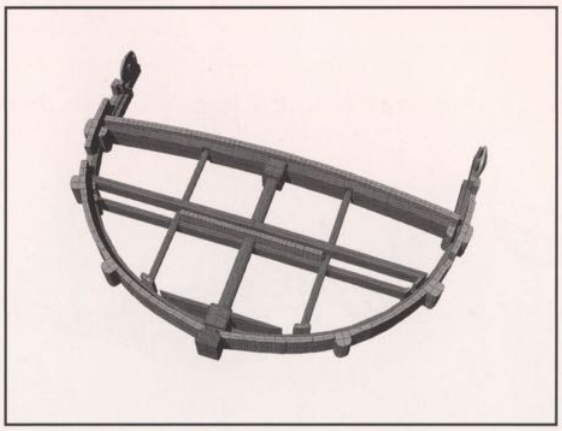


Fig. 5. *Three-dimensional reconstruction of midship section. Note Proportionss in three-dimensional composite reconstructions have been slightly altered for the benefit of presentation. Image: Alexis Catsambis*

a two-dimensional drawing cannot represent. Objects can be placed into 'layers' allowing for one to selectively view components such as frames. The true complexity of the vessel is revealed in a more simplified manner than would appear on a two-dimensional drawing. Arbitrarily color-coding selected components or shifting viewing angles only enhance this ability. The benefits are obvious when the result is presented to any type of audience, whether novice or expert in nautical matters. In effect, the ability to present complex relationships in a manner that is easier to visually comprehend allows for an enhanced ability to communicate with the public, a key principle duty of any archaeologist. At the same time, the ability to calculate factors such as volume or density certainly appeals to the specialist, furthering knowledge on the capabilities of past watercraft.

With more complete reconstructions one can then attempt to virtually test the sailing capabilities of a modeled vessel. Software used by naval architects allows them to ameliorate their designs by simulating various conditions and then testing the models for factors such as drag coefficients. This allows for us to either test the reliability of the model against known data, or, introduces us to a whole new set of data that we would otherwise ignore altogether.

Finally, technology at the Wilder 3-Dimensional Lab at the Center for Maritime Archaeology and Conservation at Texas A&M University allows for one to breach the virtual world into real space. Through the use of a Z-Corp three-dimensional printer available to researchers, one can physically print out part or the entire model, the main limitation being scale. This allows for models one can physically study and display, say in a museum. From texts, illustrations and perhaps archaeological evidence, using recent technology, the archaeologist can now present peers and members of the public a three-dimensional model in virtual or real space.

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# Where the Vessels Were Built: Reconstructing the Mongol Invasions of Japan

Randall Sasaki

Under the rule of Kublai Khan, the Mongol Empire attempted twice to invade Japan. His first attempt was in A.D. 1274 when he sent 900 ships from Korea to Southern Japan. It is said that the Mongols retreated after a day of fighting on land. The reason for the retreat is still a topic of debate, and the resources for the study of this event are limited. However, the main topic of my study concerns the second invasion that took place in 1281. Kublai sent 900 ships from Korea and 3500 ships were also sailed from Ningpo Harbor (Fig. 1). Historical documents written in this period, including Yuan shi, Koryo shi, Hachimangudouki, all agree that the Mongols approached the Takashima Island in Southern Japan when they were crushed by a sudden and violent typhoon. Through the efforts of Japanese archaeologists, remains of the fleet were discovered (Fig. 2). I received funding from the Institute of Nautical Archaeology (INA) and RPM Nautical Foundation in 2004 to conduct a preliminary study of the timbers that the Japanese archaeologists have raised. The initial analysis of the timbers found at the Takashima Underwater site can be found in the Quarterly article: "The Legend of Kamikaze: Nautical Archaeology in Japan" (Vol 32. No.1). Due to continued support from INA and RPM allowed me to continue recording the 13th-century East Asian shipwreck timbers. The main objectives of the 2005 season were to gain knowledge on the overall nature of the timbers, and make initial interpretations of the event itself. Through careful analysis of the timber, and the critical reevaluation of historical documents regarding the invasion, I began to formulate a hypothesis that the Kublai organized his invasion army knowing which nation or ethnic group would excel in each aspect of warfare.


Fig. 1. *Map of East Asia. Map: Randall Sasaki*

Fig. 2. *The Excavation from 2004 from Takashima Underwater Site. A diver discovers a part of possible frame of a small vessel. Image: Randall Sasaki*

**Hypothesis**

The Mongol Empire subjugated many ethnic groups and countries to manage the massive state. The empire had to rely on cooperation between the groups, each having different needs and resources. The two main groups that participated in the 2nd invasion of Japan were the Southern Chinese and the Koreans. Southern China, the former Southern Song Empire, was recently conquered by the Mongols; it can be presumed that they had little will to fight under the new ruler. They were valuable to the Mongol Empire because they possessed large amounts of resources, namely grains. The region was also famous for its shipbuilding, especially V-shaped cargo ships suited for long voyages. Korea, on the other hand, was not a conquered Mongol territory. To preserve his authority, the Korean king had become a close ally to the Mongol Empire. The balance of power in this alliance, however, was far from equal; the Korean king was expected to prove his obedience and his strength to the Mongol Empire. If the invasion was successful, his effort would be rewarded by gaining higher status within the Empire; it was for this reason that the Korean king supported the invasion by building vessels and allowing the Mongols and Northern Chinese to station in Korea. Despite the willingness to aid in the invasion, Korea lacked the resources to support the troops. Compared to ships built in South China, Korean vessels were much smaller, but their flat bottom

boats were suited for inland waters. This flat boat was efficient in beaching troops in narrow and shallow bays around Japanese coast lines.

Kublai no doubt realized these differences, and had to devise his plan for the invasion of Japan by carefully assigning particular roles for each country, in order to maximize the efficiency of warfare. Many Japanese historians, namely Kouki Ota, have suggested that these two army units had different purposes; by combining the two armies the Mongolian fleet became one fully functional unit. The circumstances discussed above can lead us to conclude that the most likely scenario is that the fleet from Southern China was a support unit that carried grains and other resources in their large ships to the front, while the Korean unit was the main fighting force. Kublai's word has been recorded in Yuan Shi, saying "Korean vessels were strong but small, while Chinese vessels were weaker but with a larger hold."

**From Historical Documents**

The numbers of ships, troops, and amount of grain that Kublai carried in the second invasion are mentioned in historical documents, while different sources present different numbers a range of plausible values can be used to estimate the size and general nature of the fleet (Fig. 3). Ota estimated the amount of grain consumed per person and concluded that the Eastern Army carried grain to last five to six months, while the Southern Army carried thirteen to sixteen months worth of grain. These numbers reflect the fact that the Eastern Army had an inadequate supply of grain, while the Southern Army had less number of troops but carried the main cargo of grain and other resources. It is said that the Mongols brought farming supplies and other resources, planning to create a semi-permanent settlement should the invasion succeed. Perhaps the quantities of grain mentioned in the documents – carried on the fleet from Southern China – included the resources required to maintain this settlement. Be it as it may, the number of troops mentioned in the historical record divided by the number of vessels can also be used as a rough estimate for the function of the troops; the Eastern army had 55 persons per ship and the Southern Army, 27. Although it is not expected that every vessel in the fleets carried exactly 55 or 27 persons, these numbers reinforce that idea that different functions assigned to each fleet, and the ships with more troops forming the units prepared to be the main fighting force in the front.

Written documents indicate that three types of ships were utilized in the first invasion: transport vessels, fighting ships, and miscellaneous/water supply boats, three hundred of each type. In the second invasion all 900 ships sent out from Korea are simply called "Fighting Ships." The ships built to carry the Southern Army were built in several regions, mainly in Southern China. However, historical records mention that these regions could not have produced the required number of ships in time, and that there were even rumors of localized revolts. Therefore, Kublai most likely made the decision of gathering merchant ships and older vessels from several harbors to be used for the invasion. These vessels were probably used as supporting craft; being their purpose was to carry grain and other materials to the front, the vessels did not have to be in perfect shape.

The Eastern and Southern Armies were originally planned to meet at the island of Iki around mid June, and proceed with the invasion. The Eastern Army took control of the island of Tsushima, but had to wait for the arrival of the Southern Army for several weeks; the meeting did not take place until mid to late July (Fig. 4). While in waiting, many troops of the Eastern Army were complaining that there was not enough food to eat. Perhaps they were waiting for the supplies of food to arrive. The two fleets finally met, but the destructive typhoon caught them just a few days later. It is interesting to note that the historical sources from both Korea and China indicates that most of the damage inflicted by the typhoon were suffered by the

| | Invasion of 1274 | Invasion of 1281 (from Korea) | Invasion of 1281 (from China) |
|---|---|---|---|
| Number of Vessels | 900 | 900 | 3400-3600 |
| Ship Types | 3 Types | All Fighting Ships | Not Mentioned |
| Number of Troops | 26000-30000 | 40000-50000 | 100000-140000 |
| Troops per Vessel | 28-33 | 44-55 | 29-39 |
| Amount of grain in *Koku* | Not Mentioned | 100000 | 500000 |
| Consumption Rate? | Not Available | 5-6 Month | 13-16 Month |

1 koku= Approx. 180 Liters (0.2 t)

Fig. 3. *A table summarizing the number of vessels, ship types, number of troops, troops per vessels, the amount of grain, and how long the grain would last consumed by the troops on board. (Koku is an measurement of volume in China and East Asia. The precise measurements varies from region to region and periods. It is estimated to be approximately 48 gal, or 0.2 ton) Table: Randall Sasaki*

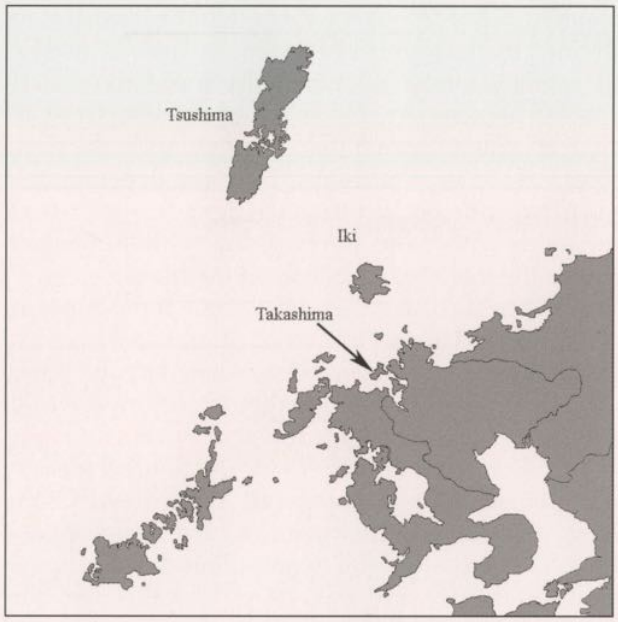



Fig. 4. *Map of Southwestern Japan*
*Map: Randall Sasaki*

ships from Southern China, and that many of the ships from Korea made it back safely.

After the failure of the first and second invasions, Kublai had a plan to invade Japan for the third time; this third invasion did not take place, however, because many of his officials advised against this attempt. It is important to note that considering the problems of provisioning the two previous invasions, this time Kublai had decided to carry the grain to Korea first, and then send out the combined fleet, though this plan never took place. Although the fleet from South China must travel a longer distance, this seemed like a safer plan than trying to meet two fleets near the enemy's territory.

**Archaeology**

The analysis of the historical documents indicates that the Eastern and Southern Armies had different functions in Kublai's second attempt to invade Japan. The archaeological remain of his lost fleet was analyzed to test this hypothesis in order to conclude whether they support the historical evidence or not. In other words, the following statements must be substantiated by the archaeological evidence. First, the shipwreck site should have a representation of various construction techniques, corresponding to the vessels gathered from various areas, mainly those situated in southern China. Second, the vessels from Southern China should have evidence of repairs and reuse. Third, the Korean ships – which may or may not be present in the sample of archaeological timbers recovered from the site – should show different construction features, such as flat bottoms and smaller scantlings. I will describe the nature of the site, the archaeological evidence it has yielded to the archaeologists, and discuss whether it confirms the information in the historical documents, focusing on the three statements mentioned above.

| | | | |
|---|---|---|---|
| RANK 1 | Nearly Complete | 32 | 6.37% |
| RANK 2 | Broken on one side | 90 | 17.93% |
| RANK 3 | Broken on two sides | 78 | 15.54% |
| RANK 4 | Highly Degraded | 140 | 27.89% |
| RANK 5 | Unidentifiable | 162 | 32.27% |

*Fig. 5. A simple list of ranking system. Table: Randall Sasaki*

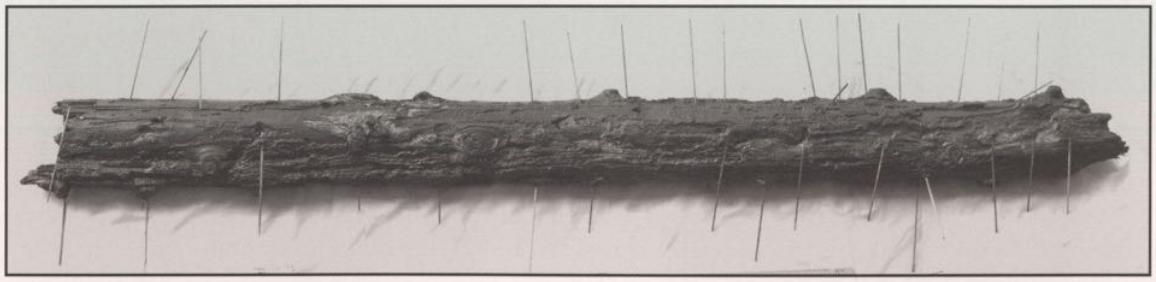
*Fig. 6. Table showing the categories used and number of timbers. Table: Randall Sasaki*

| | |
|---|---|
| Beam | 14 |
| Bulkhead Type | 14 |
| Deck Beam | 14 |
| Fastener | 4 |
| Firewood | 41 |
| Plank Type | 16 |
| Railing/Support Timber | 33 |
| Fashioned Timber | 39 |
| Wale | 3 |
| Other/Unknown | 69 |
| Unidentifiable | 160 |
| Junks, No features | 95 |

*Archaeological Nature of the Site*

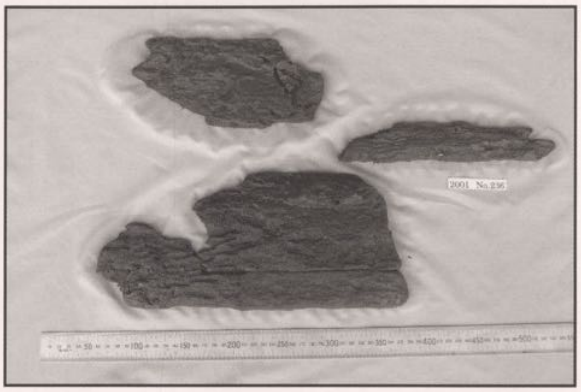
The archaeological evidence is complex because the site is comprised of multiple vessels built in various locations throughout East Asia, in addition to the fact only a small percent of the site has been excavated. The excavation was conducted as a rescue operation for the renovation of a harbor. The area excavated was close to shore where high waves continuously disturbed the sea floor. For this reason, no large sections or complete hulls of ships have been discovered. To better understand the nature of the construction techniques, I have created the database for the timbers, focusing on the supposed function of each timber recovered, its dimensions, association, and joinery. I have also assigned a ranking system to each timber fragment, reflecting its preservation; Rank 1 was given to complete or almost complete timbers, while Rank 2 when there was a fracture in one of its sides, and so on. Rank 5 was given to timbers having no trace of their original surfaces. I have created a simple table of these rankings (Fig. 5). Figure 5 shows how most of the timbers were highly degraded, and 70 % of all timbers were less than 50 cm long. This made the interpretation extremely difficult.

Within each rank the timbers were divided into categories, in order to select those where there was enough information to decipher their original function (Fig. 6). The categories attributed were: beam, bulkhead, deck-



*a.*

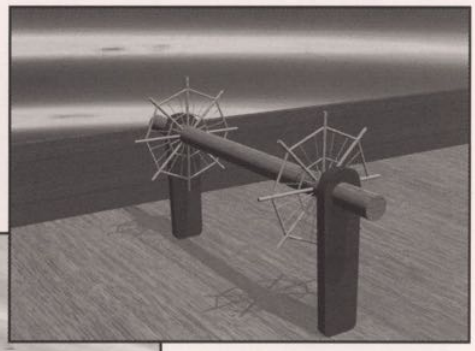

*f.*



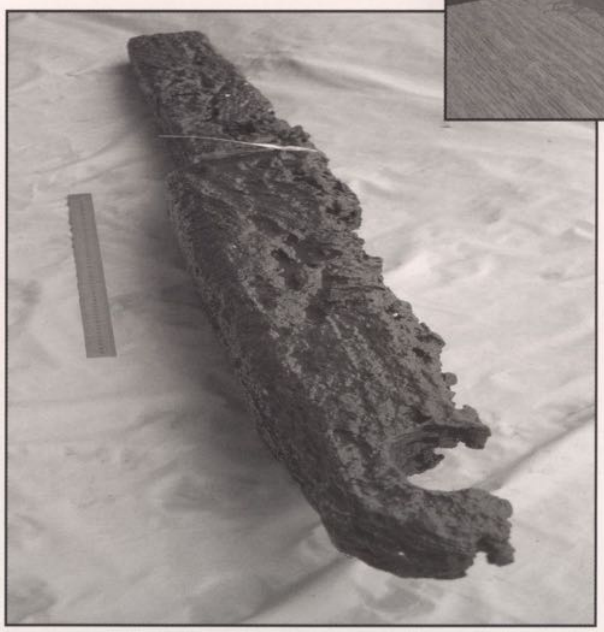
*b.*

Fig. 7. *Some of the examples of types/ categories of the timbers*
*Clockwise*
*a. wale*
*b. deck planking*
*c & d. windlass image reconstruction created in Rhino with windlass timber*
*e. unknown*
*f. unknown*

*e.*



*c.*



*d.*

planking, fastener, firewood, plank, railing, fashioned-timber, wale, other/unknown function, unidentifiable function (with diagnostic features), and junk (unidentifiable without diagnostic features) (Fig. 7 a-f). Grouping the timbers into these categories made it much easier to organize and analyze the collection of timbers recovered. The detailed discussion of the categories will be published elsewhere. For the purposes of this paper the reader should only keep in mind that the timbers were divided into categories to help realize the overall nature of the site and its formation process.

*1st Statement: The shipwreck site should have a representation of various construction techniques.*

At the first glance, most of the better-preserved ship timbers had square nails, which are typical of Southern Chinese ship construction. However, other construction techniques were also encountered. Some plank-like timbers were joined only by scarves, and other timber fragments showed both iron nails and wood scarfs' joinery. A handful of timber fragments had a different type of nails, with square sections, but tapering only near the tip.

Fig.8. *A unique bulkhead joinery method was found at the site. A recess was cut where nails will be driven in. A small piece of wood was inserted into the recess after the nail was driven. Image: Randall Sasaki*

One particular timber showed possible treenail holes, and one wooden peg or a stopper was also found. A possible bulkhead plank had small pieces of wood plugging the notches made by setting nails (Fig. 8).

The function of several timbers is still eluding shipbuilding experts because the timber shapes and joinery have not been seen before. The list of joinery and types of timbers is rich in diversity. Currently, this is the largest collection of ship's joinery types found in one single site in East Asia. The joinery types were more complex than what I have expected. The information regarding the joinery may not reveal results at this time, but will be useful for future research; we must wait for more East Asian vessels to be properly excavated, recorded, and reported.

The most impressive timbers from the site are those from the large vessels. It is obvious that large V-shaped vessels –most likely built in South China – were present in this site. Two bulkhead planks with approximately 5.7 m in length have been found at Takashima (Fig. 9). They were fastened together with iron nails driven diagonally from both sides. The same fastening pattern was found on vessels excavated elsewhere, and it is believed to be a typical construction feature of merchant vessels from Southern China. For instance, the Quanzhou ship, discovered in Southern China, has been carefully studied by Jeremy Green and is dated to the time of the invasion or earlier. I have compared the line-drawings from the Quanzhou Ship to the curve of the bulkheads from Takashima (Fig. 10). The angle of its sides suggests that this bulkhead was located close to the stern. It bears two notches, which probably indicate the positions of two lon-

Fig. 9. *A photo of bulkheads stored in a large container waiting to be conserved. Image: Randall Sasaki*

gitudinal beams that may have supported deck planking. Similar longitudinal beams can be seen in the Moko Shurai Ekotoba Scroll, a depiction of the battle scene, believed to have been drawn soon after the invasion took place. Smaller nails were used on the top plank, although there were no nails on the upper outer edge. I have interpreted this as the location where a deck structure was added. Considering the evidence, the best match occurs at the 2nd or 3rd bulkhead from the stern. It is difficult to estimate the size of the vessel, but the maximum beam may be larger than the one of the Quanzhou ship; perhaps, 10-12 m in width and 40 m in length, corresponding to an estimated 250-300 tons burden. Part of a windlass, anchors, and other larger timbers suggest the presence of other large merchant-type vessel, best fit for the long voyage.

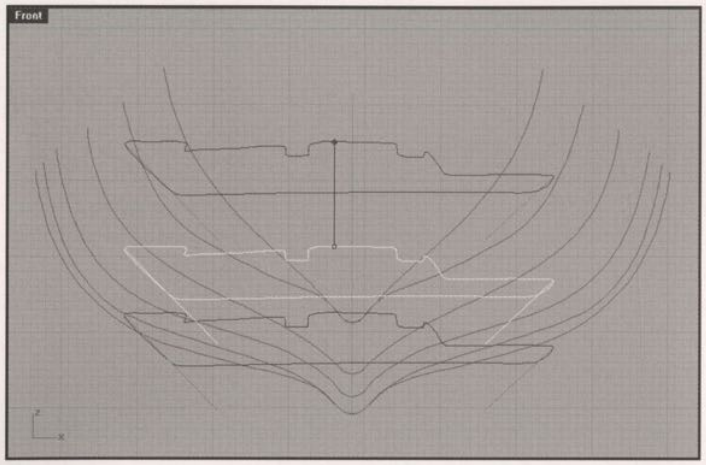



Fig. 10. *A drawing of the bulkhead, as well the lines drawings of the Quanzhou Ship was imported to Rhino®. The scale of the lines drawings and the position of the bulkhead is being changed to find the best match of the curve. Image: Randall Sasaki*

*2nd Statement: The vessels from Southern China should have evidence of repairs and reuse.*

As reported in a previous INA Quarterly article, an inscribed wooden tag found at the site mentions that "something" was repaired and inspected. Also, numerous nails driven in random order and multiple nails set at close proximity were interpreted as evidence of a repair. Among the 502 timbers recorded, 190 of them had nails, and fifteen of them showed clear signs of repair or reuse. Considering the nature of the timbers, it is difficult to determine whether the majority of the timbers are repaired. As mentioned above, most timbers found were only 50 cm long or less. Nevertheless, considering the fifteen timbers that showed clear signs of repair and reuse, it can be stated without doubt that there was a reuse and recycle of ship timbers. However, the extent of these repairs cannot be determined from the available evidence.

*3rd Statement: Korean fighting ships may or may not be present at the site.*

Chinese vessels were built using iron nails. Square iron nails driven diagonally are a characteristic type of joinery used in Southern China, as seen in the Quanzhou and Shinan Shipwrecks. Vessels found in Korea, such as the Wando boat, used complex wood joinery and no iron nails. This poses a problem when trying to identify timbers from a boat constructed in Korea. Does the absence of nails, or the presence of complex joinery asserts a certain Korean origin? Chinese shipwrights also used carved joinery, although not as extensively as Koreans did. Even some of the large timbers were difficult to determine its origin. For example, a three meter long timber had a large rectangular opening at one end. Several small nails were found around this opening, otherwise no trace of joinery with nail were found (Fig. 11). While analyzing the timbers, I have separated the timbers that were 50 cm or longer and had no nail holes, and designated them as fashioned timber. Timbers thought to be hull planks should

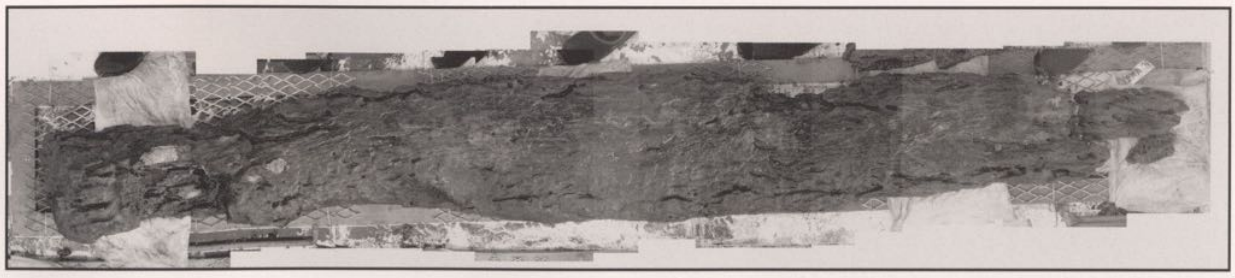


Fig. 11. *A three meter long timber that has a rectangular opening at one side. Small nails were found around the opening, otherwise devoid of any apparent joinery. Image: Randall Sasaki*

have nail holes spaced 50 cm or less, and thus these timbers without nails can be of Korean origin. The fashioned timber categories had the highest concentrations of carved joinery when compared with other categories. These may or may not be Korean in origin. Artifacts other than ship's timber may be helpful in understanding the event. More than 95% of the artifacts found on site originated in China, and only 1-2% of the artifacts are said to come from Korea. Again, it is difficult to make any solid conclusion pertaining to the presence or absence of Korean sunken vessels, but the evidence seems to support the idea that more Chinese built vessels were lost at the site.

**Conclusion**

Combined with the careful study of historical documents, interpretation of archaeological records, and the knowledge of shipbuilding technology, a new and detailed reconstruction of the historical event is possible. For the study of 2nd Mongol invasion of Japan, the main hypothesis was that each country played a different role in the warfare, according to what they were best suited for. By circumstance, the Eastern Army was motivated to fight, had strong vessels, but lacked logistical resources; the Southern Army was less motivated to fight, possessed weaker vessels, but carried the logistical resources for the both fleets.

The corresponding historical and archaeological evidence made it possible to reconstruct Kublai's plan. Instead of gathering the resources and all troops in his homeland, he decided to gather all his forces in the enemy's territory. This seemed like a good plan, which was shattered by the typhoon. Although this research seems successful, one must bear in mind that the investigation has only begun. There are still thousands of ships to find and analyze. The area that has been excavated represents only a small fraction of the entire bay, where hundreds of vessels may still lie. There are many gaps and questions regarding this research but I believe that further investigation will one day reveal the true nature of this event, the largest maritime disaster until modern time, which shaped the history of the world.

*-randy-archaeology@neo.tamu.edu*

*Acknowledgements:* This research was not possible without the support from the Institute of Nautical Archaeology and RPM nautical Foundation, and I greatly appreciate their understanding in recognizing the importance of this research. Special thanks are given to Kenzo Hayashida, a chairman of Asian Research Institute of Underwater Archaeology who has been directing the excavation at Takashima Underwater Site, as well as the Takashima Board of Education that allowed me to stay at their facilities for a period of time. I would also like to thank George Schwarz and Andrew Roberts, both NAP students, for their assistance in recording the timbers with me in Japan.

**Suggested Readings:**

Ota, Kouki
1997 *Moko Shurai – Sono Gunjiteki Kenkyu- (Mongol Invasion* – The Study of Military Aspect-) Kinseisha, Tokyo.

Sasaki, Randall
2005 "The Legend of Kamikaze: Nautical Archaeology in Japan" *The INA Quarterly* 32 (1):3-8

Rossabi, Morris
1988 *Kublai Khan His Life and Times.* University of California Press, Berkeley.

# From the Executive Director

Dear Members and Friends of INA:

I would again like to take this opportunity to introduce myself and to ask you for your thoughts and advice. After a 13-year career in the National Park Service, and 15 years as director of one of North America's premier maritime museums, I have returned to my first and true profession of archaeology. To be part of the Institute of Nautical Archaeology is an exciting change for me as an archaeologist. But I have joined INA not to dive and dig. I hope instead to bring what I have learned in my museum career to INA, especially in regard to public programs, marketing, fundraising and development.

I will be working closely with INA's Chair, Peter Way and the rest of the Board, as well as INA President Donny Hamilton and the INA staff, and Texas A&M University's Nautical Archaeology Program professors and staff to seek new projects, improve how INA communicates with its members and the public at large, and to build INA's endowment and annual funds to continue and then expand INA's mission to explore the seven seas for shipwrecks that will both add to and rewrite history.

I have been on the job now for eight weeks – and they've been busy! I have traveled with Dr. George and Ann Bass to Portland and Vancouver, B.C. to meet with some of INA's friends, and have attended meetings in Turkey and in Atlanta, Georgia as part of an exciting new project with the Michael C. Carlos Museum at Emory University and the Metropolitan Museum of Art in New York to create two major exhibitions. One will be at the Met, and the other starting at the Carlos Museum, will then travel.

Both exhibitions will feature the INA-excavated Bronze Age Uluburun shipwreck, one of the greatest archaeological discoveries of the 20th century. Founder Jack Kelley had the idea for the traveling exhibition and is spearheading this effort. I am very pleased to be able to work with him on this, especially as a former museum director.

I also went to Washington, D.C. for meetings with the National Oceanic and Atmospheric Administration and the U.S. Navy, met with Senate appropriations staffers on the Hill, and met with granting officials at the National Endowment for the Humanities. I have been also working on a new and improved website for INA, and the first stages of a new approach to how INA solicits funds.

The Institute of Nautical Archaeology is the world's leading scientific and educational organization dedicated to filling in the gaps of history through underwater exploration, excavation, and scholarship. It has set the standard for the practice of archaeology underwater, beginning with the pioneering work of Dr. George F. Bass and continuing on through the work of INA's other scientists and scholars. Those incredible achievements notwithstanding, this is not a time to rest on those laurels, but rather to strive to do more, to make even greater contributions to knowledge and public appreciation, understanding and excitement, and to reach larger, more diverse audiences.

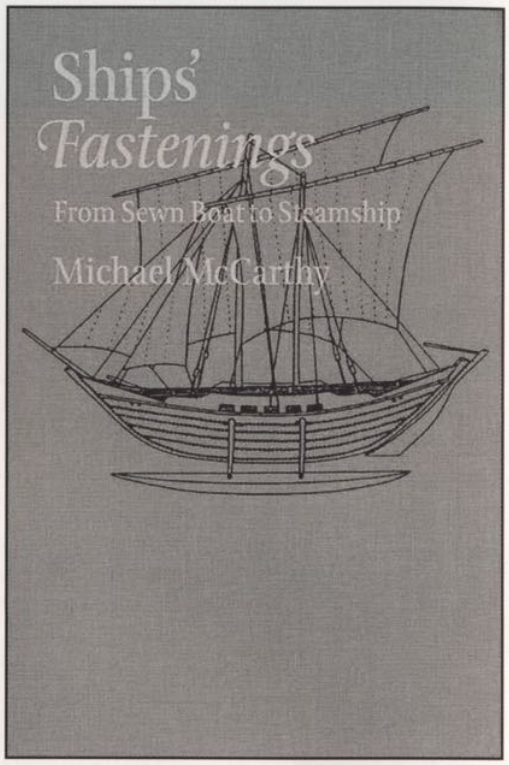
While I have "hit the water swimming," I have much to learn, and to that end I am writing you, as a friend and member of INA, to ask if you would consider sharing your thoughts with me about INA, INA's mission, and how INA can improve. Any and all thoughts and recommendations are welcome, and I hope you will contact me. I can be reached by mail, by email at jpdelgado@tamu.edu or by telephone at (604) 275-2220 or (604) 377-1340.

With thanks for your ongoing interest in and commitment to INA, I am looking forward to hearing from you if you. For those of you who have been in touch, thank you, and I look forward to further discussions.

Jim Delgado

# Just Released

*Ships' Fastenings*
*From Sewn Boat to Steamship*
by Michael McCarthy




*Texas A&M University Press, College Station 2005 ISBM 1-58544-451-0, 248 pages, 12 black and white photos, 95 drawings, bibliogrpahy, index. Hardcover. Price: $65.00*

Those interested in ship construction know all too well that the fastenings employed in a single boat can comprise a broad range of types and materials that go far beyond simple iron nails. Consequently, the complexity of hull fastenings becomes inescapable and can be quite overwhelming, whether focusing on usage over time in a single culture or performing a cross-cultural examination with remarkable differences and similarities in a geographical and chronological sense. In his book, Ships' Fastenings, author Michael McCarthy presents the first detailed study of this multi-faceted subject matter; no easy task considering the abundance of pertinent material!

McCarthy's book is the result of more than thirty years of interest and research stretching back to when he began his career in maritime archaeology in Western Australia. McCarthy outlines the myriad of ship's hull fastenings used throughout the ages in remarkable detail, presenting a book with high information density. His research encompasses the combination of archaeological, ethnographical, historical and archival records.

The publication of a general and interdisciplinary book such as Ships' Fastenings is an important addition to every nautical library, especially since the study of Ships' Fastenings has been relatively suppositious within the field of nautical archaeology. McCarthy specifically focuses on fasteners "that appear in, or on, a hull serving to secure it in service." He excludes those fastenings used to secure the upper-works, rigging, and ropes, unless they have a dual function and are also used to join hull timbers. Caulking and luting are only included if they are specifically designed to swell or tighten a joint.

The first six chapters of the book offer a thorough description of fastening techniques used in sewn-plank boats from the ancient world and ethnographic evidence. He discusses the use of organic, metal, and wooden fastener's in the Celtic, Chinese, and Mediterranean shipbuilding traditions, followed by the clinker and carvel construction methods of Northern Europe.

The subsequent chapters are a comprehensive account of ship fastenings used predominately in the Anglo-American world from the seventeenth century up to twentieth century. In these chapters, the international scope of the first half of the book is largely abandoned in order to provide greater focus and clarity to specific details of manufacturing, sheathing, and metallurgy.

McCarthy touches on local varieties and traditions throughout the world from past to present, which make his study complicated, especially since different materials and techniques of fastenings are used within the same constructional concept depending on time and place. Words for the same fastener may differ per location but they may also differ per scholar, as is exemplified in McCarthy's book when he describes the construction of the Egyptian boats found near the pyramid of the 12th-Dynasty pharaoh Senwosret (Sesostris) III at a place called Dashur, in which dovetail fastenings are used at the surface across the seams of adjoining planks. Scholars do not refer to these fasteners using a consistent terminology and McCarthy explains how they can be called dovetail clamps, dove-tail keys, double dove-tail clamps, or simply dovetails.

By the same token, seemingly simple terms can refer to a wide range of different types of fasteners. Take for example the word treenail (trunnel, trennal, traynal, and so on). Treenails can be long, cylindrical, wooden pins used to affix the upright timbers of a ship to its planking, as seen in Northern European shipbuilding during the Medieval and Post-Medieval periods. In the ancient Mediterranean, treenails could be wooden plugs inserted into pre-drilled nails holes to ensure water tightness and prevent damage to the planking when driving copper nails through them to fasten frames to the hull planking. McCarthy explains how, according to the Oxford English Dictionary, treenails are "cylindrical pin of hardwood used in fastening timbers together esp[ecially] in shipbuilding and other works where

materials are exposed to the action of water." Then he illustrates how they are not necessarily circular in section, but can be also octagonal, and elaborates on a wide range of treenail types including wedged (inside and/or outside), pegged, blind, and through treenails.

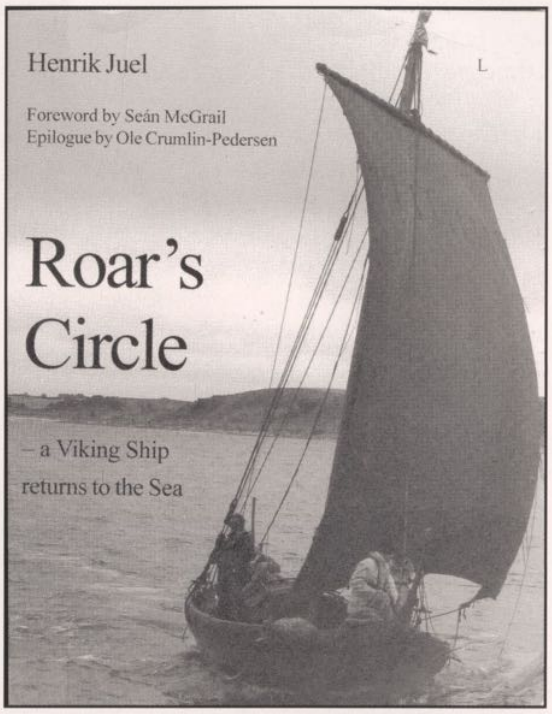
Ships' Fastenings is essentially a technical handbook indicating all sorts of complications that scholars face trying to study something seemingly as simple as a fastener. Although clear explanations of terms are provided throughout the book, its nautical jargon and scholarly level do require some background knowledge of the subject matter and terminology. Considering the complexity of the book, higher quality and more detailed illustrations would have improved its visual aids for better understanding of some technical and intricate descriptions in the text. McCarthy does, however, elaborate throughout the book on specific fastening techniques by presenting a variety of examples to clarify them. In doing so, McCarthy touches upon the work of many scholars and accredits them for their work. He does not seem to have omitted any relevant research or researcher as he wades through the many aspects of ships' fastenings!

As a supplemental textbook, it belongs in intensive introductory and advanced classes in nautical archaeology. In addition, it is a valuable guide to take into the field for archaeologists involved in shipwreck studies or ethnographers studying traditional shipbuilding. Ships' Fastenings provides a good overall synopsis for historians, ethnographers, archaeologists, shipbuilders, ship modelers, and for those individuals actually interested in such particularities.

*- Wendy van Duivenvoorde*

# Just Released

*Roar's Circle*
by Henrik Juel




*The Lutterworth Press, Cambridge 2005*
*ISBN 0718830458, 160 pages, Paperback. Price: £15.00, US$30.00.*

Anyone who has ever had any contact with nautical archaeology must have heard about famous Skuldelev ships. These incredible vessels, excavated during the summer of 1962 from the waters of Roskilde fjord in Denmark, provided archaeologists with invaluable evidence of late-Viking era shipbuilding. Two of these mid-eleventh century ships proved to be cargo carriers, two others were Viking longboats (warships), and the fifth one a small Norwegian fishing boat. This pioneering work not only set the foundations for Viking Ship Museum in Roskilde, but also for multitudinous other research and reconstruction projects all over Scandinavia. In this context, Henrik Juel's Roar's Circle presents a personal view on one of the first such ambitious projects, a project which certainly opened a new chapter in Scandinavian maritime archaeology.

Roar's Circle is an informative, readable, and quite pleasant book. It encompasses a two year period, between 1982 and 1984, during which a team of Danish amateurs and nautical enthusiasts began an experimental work of recreating the Skuldalev 3 ship. This remarkable vessel was a small cargo carrier built around 1040 AD. As the title suggests, this project was designated as Roar and the replica received a name Roar Ege (Roar's Oak Ship.)

In a very simple format the author managed to convey all of the nuances and complex problems of Viking-era shipbuilding. Juel continually emphasizes that the aim of this project was not just to build a replica, but to build it using the original materials, techniques, and tools. He talks not only about all the technical problems of building a modern version of an original Viking ship, but also about the everyday interactions between team members. Step by step, he presents the development of this incredibly complex but still beautifully simple floating masterpiece from both perspectives. On one hand he meticulously describes highly technical aspects of this project, while on the other hand he also does not omit its humorous, and at times silly, personal side.

Juel openly states that from the "scientific-historical experiment" point of view it was surprisingly informa-

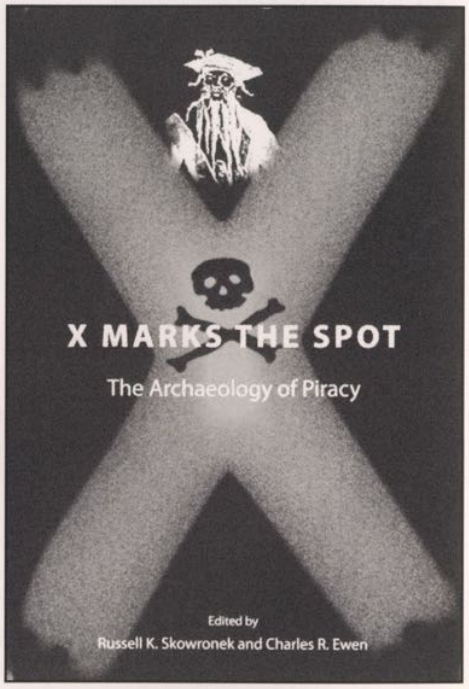
tive to have so many unexpected problems with this replica. Knots in the keel timber or planks, the warped surface of the after stem, and the appearance of numerous splits and cracks, are presented here as departure points for further investigation and research. As the original builders vanished so did their wisdom and oral tradition, and decades later people like Roar's team had to start all over again. Juel describes how some of these forgotten techniques could only be inferred from and brought to life again by the faint tool marks, by careful study of the Bayeux Tapestry, or from simple educated experiments.

Roar's Circle presents all the steps, tools, techniques, and ways of dealing with problems encountered in nautical reconstruction. It is not, however, a research publication but rather a very personal account of a shipbuilding project. Even though it lacks rigorous technical language, it succeeds in teaching the reader about many nuances of the Viking ships. Regrettably, Henrik Juel is too personal at times and brings forth so many irrelevant personal details that it makes one wonder what all this has to do with the actual vessel. Nevertheless, if you are interested in reading about a highly personal account of the creation of a replica of the Skuldalev 3 ship, this book is definitely something to consider evaluating.

*-Piotr Bojakowski*

# Just Released

*X Marks the Spot: The Archaeology of Piracy*
Edited by Russell K. Skowronek and Charles R. Even




*University Press of Florida, Gainsville 2006 ISBN 0-8130-2875-2, 384 pages, 153 black and white illustrations, 20 tables, bibliography, index. Hardcover. Price: $55.00*

Russell Skowronek and Charles Ewen's edited volume, X Marks the Spot: The Archaeology of Piracy, summarizes the current knowledge on the archaeology of pirate ships and settlements, as well as the modern perception of piracy. Through 14 articles, including one by INA President Donny Hamilton, the contributors describe sites associated with pirates and attempt to develop a typology for the archaeology of piracy. The combined works provide a healthy mix of descriptive articles, detailing the artifacts and archaeology of pirate sites, and theoretical pieces on the nature and effects of historic piracy. While most of the articles focus on the Golden Age of Piracy (1690–1730) on the Atlantic and Indian oceans, piracy during the 19th century (e.g. Jean Lafitte) and in other regions (e.g. the Ohio and Mississippi rivers) are discussed.

Archaeology is a generalizing science that studies cultural patterns, and this book asks repeatedly, "is there an archaeologically recognizable pirate pattern." The answer again and again is "no." All of the terrestrial pirate lairs discussed in the text (Port Royal, Bay of Honduras, and the Jean Lafitte camp) resemble active and legal trading communities or squatter camps, while the archaeologically investigated pirate ships (Speaker, Fiery Dragon, Whydah, and Queen Anne's Revenge) are indistinguishable from well-armed merchant vessels or slave ships. Without historical documentation it would be impossible to connect these sites with piracy. Skowronek correctly posits that the ability of pirates, like modern gang members, to pass for law-abiding citizens was one of their greatest defenses.

Unfortunately, these findings leave the archaeologist cold. It may be that, in the case of piracy, archaeology is the hand-maiden of history. Piracy was a world-wide phenomenon perpetrated by individuals; individuals are the subject of history; while archaeology generally deals with the masses. Rather than focusing on specific pirates or vessels, Skowronek and Ewen's article exploring the material effects of piracy in the Spanish Caribbean suggests Spanish fortifications and the presence of contraband ceramics as avenues for studying the impacts of piracy. This approach needs to be developed further but offers a viable alternative for the archaeology of piracy, studying patterns throughout a region instead of searching for specific examples.

Despite the difficulty of identifying pirate sites, the book successfully provides a baseline and comprehensive

bibliography for future investigations. Armaments of varying calibers, mixed cargoes, equal distribution of wealth between forecastle and aft cabin, and sumptuous clothing are advanced as possible identifiers of pirates and pirate ships but none can be proven conclusively from the available sites. Lusardi's article on the Beaufort Inlet Shipwreck (popularly identified as Blackbeard's Queen Anne's Revenge) is particularly interesting in that it explicitly explores the standard of evidence applied to identifying pirate ships. While the standard Lusardi demands may be too high for most archaeological sites to meet, he raises numerous interesting points about what defines a pirate wreck. The discussion of what constitutes a pirate site and how a wreck can be tied to a specific ship is of interest to maritime archaeologists in general.

Ultimately, X Marks the Spot is an interesting book and is valuable because it opens a dialogue on one of maritime archaeology's most intriguing and poorly understood aspects. The connection between pirates, treasure, and maritime archaeology is unfortunately natural to the lay public. Skowronek and Ewen's collection provides archaeologists with the information to address questions about the material culture of piracy and why it is so difficult to identify pirate ships. With the data presented here many of the misconceptions of piracy can begin to be dispelled.

*- Ben Ford*

# News and Notes

## Center for Maritime Archaeology and Conservation Lecture Series

The ships of the Dutch Golden Age were intricate and complicated machinery. Beautiful, sturdy, and reliable, they stand today as an important chapter in the history of European technology. Yet only few study this complicated aspect of Dutch seafaring.

Mr. Ab Hoving is one of those very few. He is recognized by the international academic community as one of the world's renowned specialists in historic shipbuilding, and undoubtedly the most knowledgeable scholar in the field of Dutch shipbuilding from the late 16th century onwards.

His books and papers –well-researched, comprehensive, concise, and clear– have been part of the mandatory readings for students in the Nautical Archaeology Program. Consequently, his work has inspired many students to following his footsteps and experiment with wooden models in order to try and understand the logics of shipbuilding technology better.

It must be noted that Mr. Hoving does not perform his research alone; as a true scholar, he works closely with his colleagues during the reconstruction of Dutch ships. His cooperation and joint research efforts with other zealous and excellent ship model builders and/or illustrators, such as Cor Emke, Gerard de Weerdt, and Alan Lemmers, have played an important role in the recently published series of books and consequently their success.

Mr. Hoving's name was one of the first ones to be mentioned when a lecture series was initiated for the new Center for Maritime Archaeology and Conservation. Consequently, staff and students were delighted when he accepted to visit College Station for four days to give a talk on his research, spend time with students and faculty, discuss shipbuilding, and confer about the possibility of publishing the English edition of his publication Nicolaes Witsens scheeps-bouw-konst open gestelt by Texas A&M University Press. The publication of such important translation will make Witsen's work, at least part of it, more accessible to foreign scholars, shipbuilders, historians, model builders and those otherwise interested.

*Ab Hoving speaks for an audience of students, faculty and guests sponsored by CMAC. Photo: Filipe Castro.*

Mr. Hoving visited College Station from April 4 to 7, 2006 and was a bit surprised to discover that he has a serious fan club in College Station. His visit was not only beneficial to the Nautical Archaeology Program…but also to himself. During a tour of the Conservation Research Laboratory on the Riverside Campus by Helen Dewolfe (like Mr. Hoving from Groningen descent), he was keen to learn about silicon-oil treatment for the conservation of shipwreck artifacts. As the curator of the ship model collection of the Rijksmuseum, Mr. Hoving hopes that the silicon-oil treatment may work very well to support the fragile material of the standing rigging of the period ship models from the museum's collection.

*-Wendy van Duivenvoorde*

# INSTITUTE OF NAUTICAL ARCHAEOLOGY