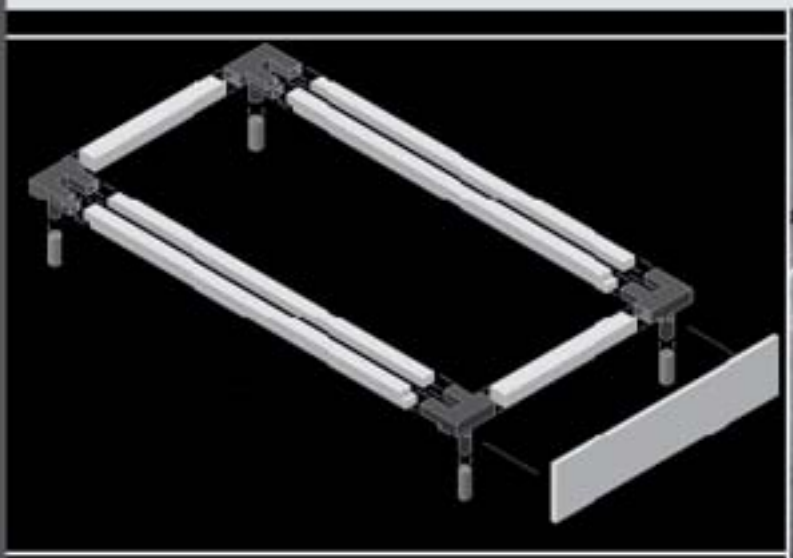
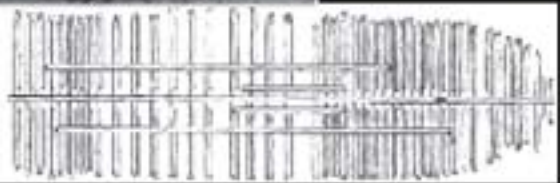
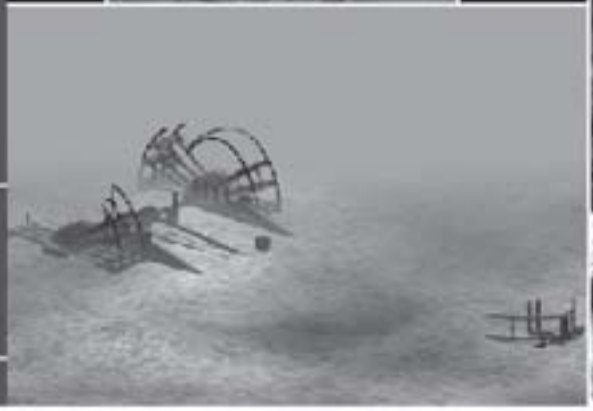
2009 Projects and Research

INSTITUTE OF NAUTICAL ARCHAEOLOGY

THE INA annual







The Institute of Nautical Archaeology is a non-profit organization whose mission is to continue the search for the history of civilization by fostering excellence in underwater archaeology.

The INA Annual is published every year by INA with an editorial advisory board of Texas A&M University faculty, INA staff, and scholars from other associated institutions of higher learning and study. It examines projects and research conducted by INA Research Associates and the Nautical Archaeology Program faculty at Texas A&M University, in the previous calendar year. As well as being offered in printed form, *The INA Annual* is available online and is one of the many benefits of INA membership. More information on becoming an INA member can be found at inadiscover.com or by contacting INA at (979) 845-6694.

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INA Research Associates

INA's research associates and affiliated faculty hail from all over the world. They include senior scholars and associated faculty from other universities as well as emerging scholars–graduate students–mostly drawn from the ranks of the Nautical Archaeology Program at Texas A&M University. This diverse, multi-disciplinary and highly specialized group of people continue to further our prime directive–to bring history alive through the scientific means of surveying, excavating, conserving and, where possible, preserving shipwrecks. Everyone on the team is passionate about what they do and has incredible knowledge, skills and field experience. Their biographies reveal a glimpse of the extraordinary work that has been accomplished and demonstrate how dedicated each is to their craft. We applaud them and thank all for their contributions to INA and to nautical archaeology.

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With Thanks...

The Institute of Nautical Archaeology acknowledges and thanks the generous donors, sponsors, friends and partners who made its work in 2009 possible.

For many years, the Institute of Nautical Archaeology has benefited from the support of major partners who make a substantial difference to what the Institute is able to deliver.

Since 1974, INA's headquarters in the United States has been located at the College Station campus of our principal partner, Texas A&M University. Through the University, and in particular through the College of Liberal Arts, and the Department of Anthropology, the Nautical Archaeology Program and the Center for Maritime Archaeology and Conservation (CMAC), and with the assistance and partnership of the Texas A&M University Foundation, INA directors raised and donated funds that the University matched to create the Nautical Archaeology Program's endowed chairs and fellowships that are now held by some of the world's top nautical archaeologists. The Nautical Archaeological Program, through its faculty and students, have been the primary means by which INA projects have been carried out through the decades. INA is also fortunate to work with the Texas A&M University Press, which through its publishing program, and with the specific support of the Ed Rachal Foundation, has been able to create the premiere publication series in nautical archaeology in the United States, if not the world.

INA has also been supported for many years by the RPM Nautical Foundation which works to survey important waters and provides INA with the opportunity to excavate significant sites they encounter. INA also recognizes the Turkish Institute for Nautical Archaeology (TINA), another major partner, strong ally and friend. This partnership in particular underscores the importance of Turkey and its significant nautical archaeological heritage to the work of INA. Other major partners include countries and states that grant INA researchers both permission and the privilege to work on sites under their jurisdiction.

INA's 2009 donors are recognized on pages 101 and 102 of this publication. For more information on supporting INA, visit **inadiscover.com** or contact the INA office.

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To learn more about the growing record of projects undertaken by INA over more than five decades of exploration, go to **inadiscover.com**.

Jim Delgado
President & CEO
Institute of Nautical Archaeology

2009 in Review
A Report from the President

Founded in 1973, the Institute of Nautical Archaeology was in its 37th year of operation in 2009, and approaching the 50th anniversary of the first scientific archaeological excavation of a shipwreck under water at Cape Gelidonya in 2010. Hundreds of shipwrecks, drowned ports, lost cargoes and prehistoric sites have been scientifically excavated, studied and the results published around the world in the last five decades. Through those years, INA has been at the forefront. Since our founding, INA and its members, associates, students and affiliated faculty have worked on more than 180 projects in nearly every ocean, in major lakes, and off nearly all continents. Hundreds of scholarly and popular articles have been published. An impressive shelf of dozens of books, almost all published in partnership with Texas A&M University Press, has shared the results of that scholarship.

What is paramount is continuing to conduct surveys, assessments, excavations, and to continue the excavations in the laboratory through conservation and analysis as we interpret the results and then share them. In 2009, the Institute of Nautical Archaeology, in conjunction with Texas A&M University's Nautical Archaeology Program, Flinders University, and the RPM Nautical Foundation, was a participant, partner, or supporter of 17 archaeological projects around the globe in the United States, Canada, Bermuda, the Bahamas, Turkey, Spain, Lebanon, Cyprus, Sweden, Italy, Ukraine, Japan, Vietnam and at sea between Crete and Egypt. Eleven of the projects were ongoing, and six were new initiatives. These included:

- **the final season of excavation** of a 1st-century BCE Roman Period wreck at Kizilburun, Turkey focused on the buried remnants of the hull formerly covered by the ship's cargo of massive marble column drums, some of which were recovered for treatment and display ashore;
- **the second season of excavation** on a 7th-century BC Phoenician shipwreck off Cartagena, Spain following initial dives that yielded well-preserved elephant tusks with Phoenician inscriptions, amber and ceramics;
- **a second season of field survey** and documentation in Canada's remote Yukon wilderness, where the the remains of Klondike Gold Rush era steamers and the well-preserved wreck of *A.J. Goddard*, discovered in the subarctic waters of Lake Laberge in 2008, were central to dives and documentation;
- **the third season of a deepwater survey** between Crete and Egypt that followed the route of ancient mariners in the hope of finding a Minoan shipwreck;
- **the re-survey** of an ancient wreck located in INA survey years ago at Kekova Adaşi, Turkey, part of a collaborative project with Brock University in Canada;
- **a National Geographic Society funded survey** and assessment of the site of a famous battle outside Hanoi where Mongol invaders sent by Kublai Khan met with defeat in 1288;
- **the investigation**, in partnership with the Great Lakes Historical Society, of the

remains of *Anthony Wayne*, a mid-19th century side-wheel steamer that met a tragic end off the shores of Vermilion, Ohio in 1850;

- **a land-based survey** to find sites associated with British maritime and mercantile activity from the late 17th and early 18th centuries at Harbour Island, a British settlement in the Bahamas;
- **the documentation** of timbers from an early 17th-century wreck, previously excavated in Bermuda;
- **an ongoing assessment and study** of rare Venetian manuscripts dating from 1500 to 1620 that continued to add to our knowledge of Renaissance shipbuilding in this center of Mediterranean trade and culture;
- **a survey of shallower water sites**, set on Cyprus' ancient shores, seeking shipwrecks, lost stone anchors, discarded amphorae and other remains from maritime activity;
- **the completion of a detailed report** on the submerged features, shipwrecks, docks and setting of a section of Lake Ontario, including the scene of naval action in the War of 1812, following the final 2008 season of survey;
- **ongoing preparation of the final archaeological report** and other publications on the Confederate blockade runner *Denbigh*, wrecked in Texas waters;
- **a two-month study**, documenting and transcribing the markings on medieval storage and transport jars based on the collection of five types of amphorae from an AD 13th-century wreck excavated in the Bay of Sudak, off Novy Svet, Ukraine;
- **survey and excavation** of the site of a tragic 1890 shipwreck of an Ottoman naval frigate on a mission to Japan again involving a joint Turkish-Japanese team;
- **laboratory analysis** of amphorae recovered from the Yassi Ada excavation to determine their capacity and to assess standardization in that era, based in the Griffis Conservation Laboratory at the Bodrum Center;
- **surveys** by the RPM Nautical Foundation off the coasts of Albania and Sicily that made several key discoveries including two World War I vintage vessels, and a test excavation of a Roman shipwreck.

All of these projects were made possible by the generous support of partners, sponsors, and donors, volunteers, and the permission of and permits granted by the various nations and states where the projects took place. Also key to the success of these projects and INA's ongoing work and involvement is our endowment, managed by the INA Foundation and built up with generous gifts. INA and the various project directors and participants offer their thanks to all of those who made 2009's work in the field, in the laboratory, and at the computer possible.

In 2010, INA stands in a position of relative strength. It has focus, a strategic plan, a dedicated core of supporters, an engaged and committed board of directors, and it continues to attract support, including donations and grants. INA has a clear sense of its mission, its focus, and its priorities. There are exciting, ongoing projects that will yield enthusiasm and interest as well as archaeological and historical knowledge, and partners and alliances that will continue to enable INA to conduct its work and fulfill its mission.

That mission, in 2010 and beyond, continues with a special emphasis on those key elements that we focus on as we pass our 50-year benchmark:

- Saving the endangered past through advocacy and action;
- Demonstrating and supporting "best practice," in everything we do;
- Collaborating and partnering on an international scale with universities, programs, scholars, students, museums, organizations, and institutes;
- Sharing knowledge with a diverse and global audience through a wide variety of media and particularly enhancing our ability to do so through the Internet;
- Demonstrating the relevance of what we do and why we do it;
- Mentoring and supporting the new generations of nautical archaeologists;
- Being cost effective and strategic in our work; and
- Being socially and environmentally responsible.

Thank you for your interest in INA, what we do, and for your support. It makes a difference.

Mark E. Polzer INA
Juan Pinedo Reyes INA

Bajo de la Campana 2009 Phoenician Shipwreck Excavation

FIG 1 above
Divers prepare to move one of the many boulders littering the site. Photograph by M. Polzer, June 2009.

FIG 2 inset
The tip end of an elephant tusk with inscribed lines. Photograph by L. Thomas, August 2009.

The Institute of Nautical Archaeology completed its second season of excavation at Bajo de la Campana, off the southeastern coast of Spain, in 2009. The expedition team focused its efforts on remains from an Iron Age Phoenician vessel that sank there at the end of the seventh century BC. Previous surveys and inaugural excavation campaign in 2008 had turned up Punic and Roman material from a second-century BC and a first-century AD shipwreck as well, but Phoenician material predominated.[1] The latter was concentrated in the crevasse and cave, along the eastern face of the shoal, and downslope across the northern part of the site.[2] Our goal for this year's campaign was to locate the main part of the Phoenician wreck and determine what, if any, of the ship remained.

Excavation

In 2008, the team had worked systematically to excavate the entire breadth of the site, beginning at the base of the shoal and moving down slope to the east. Our purpose was to assess the general distribution of the Phoenician and Punic/Roman assemblages in order to determine the disposition of each shipwreck. While this proved somewhat successful in helping us make sense of the overall site, it was inefficient due to the large number of rocks and boulders that we had to move. Furthermore, the Phoenician material was not only preponderant, but it was also the most varied and archaeologically interesting. For these reasons, we narrowed the focus of the excavation to the Iron Age shipwreck only and, accordingly, targeted the northwestern sectors of the site.[3]

FIG 3 top
Fragments of wooden logs found near the cave. Photograph by M. Polzer, June 2009.

FIG 4 above
Worked wooden object, possibly a basket handle. Photograph by Mark Polzer, June 2009.

The expedition ran from June 11 to August 25, and included 47 days of diving. We spent almost the first three weeks of diving preparing the site, which included laying grid lines, positioning and measuring mapping control points, and, most of all, clearing rocks (Figure 1). Rock removal is the most demanding aspect of our underwater work at this site, both physically and time wise, especially since we have to put many of these same rocks back onto the site at the end of each summer to protect it from looting during the off-season.

The Finds

One of the first orders of business, once airlifting got underway, was to uncover and finish excavating the group of elephant tusks and wooden elements that we had discovered at the end of the 2008 campaign.[4] One of the tusks, a large tip end, is decorated with inscribed perpendicular lines (Figure 2), but we found no additional written inscriptions on any of the new specimens. The two pieces of wood lying beneath the tusks turned out not to be part of the ship's hull structure, as we had hoped, but instead are large pieces of branch wood that would appear to be cargo. The logs were chopped with an ax, as evidenced by distinct cut marks at the preserved end of the larger piece (Figure 3). In addition, beneath the tusks we found numerous fragments of worked wood, including a possible basket handle (Figure 4) and another two or three wooden combs,[5] a tin ingot and more galena, and a stash of pine nuts and pistachios that was stored in a sack, of which nothing but its impression in the surrounding sediment remained.

The other material recovered during the first month and a half of work was much the same as from the previous season,[6] with a few important exceptions. Our work yielded a greater variety and amount of Phoenician pottery, which is important to help us fine-tune the date of the wreck. However, all of the ceramic finds, with the exception of one small jar, consist of broken and scattered sherds. Thus, the types and numbers of vessels given in this and earlier reports are necessarily preliminary estimates, until cleaning, conservation, and restoration of the pieces are completed. We found a piece of the wreck's first oil lamp this year. Unfortunately, the wick-end is missing, so we cannot yet determine whether it had one or two nozzles, nor confirm whether it was the ship's lamp, which would be evident from charring around the nozzle indicating use. This type of lamp is essentially a small dish with a wide rim and one or more trough-like nozzles—formed by pinching the rim at one end, to hold a wick. Lamps with two nozzles are known from Iron Age sites across the Mediterranean and beyond: from Sarepta, in Phoenicia proper, to Mogador, on the Atlantic coast of Morocco. However, they are found infrequently in the East, while being prevalent in the central and western colonies, where they are found often in graves.[7] Establishing a chronological sequence differentiated by the number of nozzles has proven problematic, and both types have been found in seventh- and sixth-century BC deposits.[8]

The ship was carrying two types of Phoenician transport amphoras: half

a dozen or so Vuillemot types R-1[9] and several Cintas types 268.[10] The first type was produced in colonial workshops in Spain and North Africa around the Straits of Gibraltar, and has a wide distribution that stretches from Atlantic Morocco to the Tyrrhenian coast of Italy.[11] The distinct clay fabric of at least some of the R-1 fragments from Bajo de la Campana indicates that these particular amphoras were produced in the region of Málaga, on the southern Mediterranean coast of Andalusia.[12] Amphora finds from these potteries are dispersed predominately throughout southern Spain—from Gadir (Cádiz) in the southwest to Peña Negra (Crevillent) in the area of Alicante, to the north of Bajo de la Campana—but they have been found as well at Lixus (Larache) in Morocco, at Aldovesta (Benifallet) in Catalonia, at Carthage in Tunisia, and at Pithekoussai, the site of a Euboean settlement on the island of Ischia in the Gulf of Naples, where Phoenicians are known to have settled as well.[13] They were produced from the late eighth into the second half of the sixth century BC, but especially during the seventh century, when the western colonies enjoyed their greatest period of growth and commercialization.[14] The type does not have a firm association with a particular product, but its common presence with wine paraphernalia in both Phoenician and indigenous tombs suggests that it may have been used typically to carry wine.[15]
The second type of amphora has an ovoid shape and was produced in Phoenician settlements on the central Mediterranean islands and along the North African coast.[16] Examples have been found in Sicily, Sardinia, Malta, Italy, and from Morocco to Tunisia, but the type is best represented at Carthage, Motya (Sicily), and Sulcis (Sardinia).[17] This amphora is somewhat rare in the far western colonies, where its distribution is limited to Ibiza and the Mediterranean coast of Spain, with the exception of examples found at Gadir.[18] The type is generally dated from the end of the eighth century, or beginning of the seventh, to the first part of the sixth century BC, and enjoyed its peak production around 625–575 BC.[19]

Two new items from the shipwreck came to light this year. Globules of a dark, resinous material, most likely resin or pitch, were found in the central part of the site.[20] The amount recovered so far suggests one or two amphora-loads, which leaves open the question of whether the material was cargo or for use onboard the ship. Resin or pitch cargoes have been documented on more than a dozen shipwrecks from antiquity spanning two millennia.[21] The material was typically transported in amphoras, but also as blocks or bulk material. The Syro-Canaanite ship that wrecked at Uluburun, Turkey, was carrying approximately one ton of Pistacia (terebinth) resin in more than a hundred Canaanite jars.[22] The cargoes of the Archaic Greek shipwreck at Giglio, contemporary to that at Bajo de la Campana, and the Classical wreck at Porticello included amphoras full of pitch; the jars of the former being Etruscan.[23] Additionally, transport amphoras in antiquity were often coated internally with pitch or resin, which is believed to indicate an original content of wine.[24] The coating material not only rendered the ceramic containers impermeable, but it also served to flavor the contents.[25]

Pine tar, or a mixture of tar, wax, and resin, was used as well for paying ships' hulls and coating cordage in order to resist marine fouling, and also to waterproof, seal, and caulk the hull wood and seams. The practice was common in antiquity, and the elder Pliny notes in his *Naturalis Historia* (35.149) the effectiveness of these materials due to their imperviousness to sun, wind, and seawater.[26]

In the same general area we uncovered a large amount of earthen material—reddish-brown in color with dark inclusions, and a somewhat hard and dry texture. At first, only small clumps of the material came to light, but then, towards the end of the season, large amounts, extending across entire sectors, were uncovered but left *in situ*. Analysis is required to positively identify the material, but it may be some type of clay destined for a pottery workshop,[27] or a mineral such as iron or lead oxide—what the ancients called míltos (red ochre) and minium, respectively—which were used throughout antiquity as pigments.[28] Red ochre occurs naturally, but also is produced by heating (yellow) ochre, while minium is commonly found in silver or lead mines. According to Pliny (33.37, quoting Theophrastus), Spain was an early known source for minium and, in the author's day (first century AD), was its main supplier to Rome. Some two thousand pounds per year of the raw mineral were brought to the city, where then it was reduced and refined. He also notes (33.40) that it was used

FIG 5
A small bottle for scented oil or perfume. Photograph by M. Polzer, June 2009

FIG 6 above left
Ivory knife-handle.
Photograph by L. Thomas, July 2009

FIG 7 left
Two sets of bronze objects. The two pieces lower left are shown interlocked, as they were found on the seabed.
Photograph by M. Polzer, August 2009.

FIG 8 above right
Detail of one of the bronze fittings.
Photograph by M. Polzer, August 2009.

for inscriptions on tombs. While the total amount of this material will not be known until we remove it all from the seabed, it clearly represents a substantial part of the cargo, in terms of both space and weight.

Luxury Items

The most exciting developmentof the season came during the concluding days of excavation, when it appears that we finally reached the main wreck level at the northern extent of the site and at a sediment depth of 1.5 m. There we partially uncovered what may be a piece of the ship's hull. The exposed portion was almost half a meter in length, 11 cm wide, and up to 5 cm thick. Unfortunately, we could find no evidence for edge fastenings, but a diagonal scarf extends along the lower edge of the piece. The timber's exposed surface, presumably its inboard face, shows remnants of a pitch coating in which nuts and pieces of dunnage are imbedded. Next to the wood we found an assortment of singular objects, including the first and only intact ceramic vessel yet found on the wreck—an unguentarium or arryballos, which were small bottles used for scented oils, perfumes, and ointments (Figure 5).[29] The jar has a globular body with no base, a narrow mouth and flaring rim, a slender, curving neck that bulges just before it joins the body, and a single handle that spans the neck-body join. It is approximately 11 cm tall and has a maximum diameter of almost 7 cm. Apparently, examples found so far on Archaic-period sites have all been imports from Phoenicia proper, even though finds of this type are rare in the east.[30] They are widely distributed across southern Spain.[31] The shape variations of these vessels are difficult to frame chronologically, but the type seems to have been used frequently in the eighth century BC and did not continue much beyond 600 BC.[32] The longer, more graceful neck and the rim flare of our example puts it no earlier than the seventh century BC,

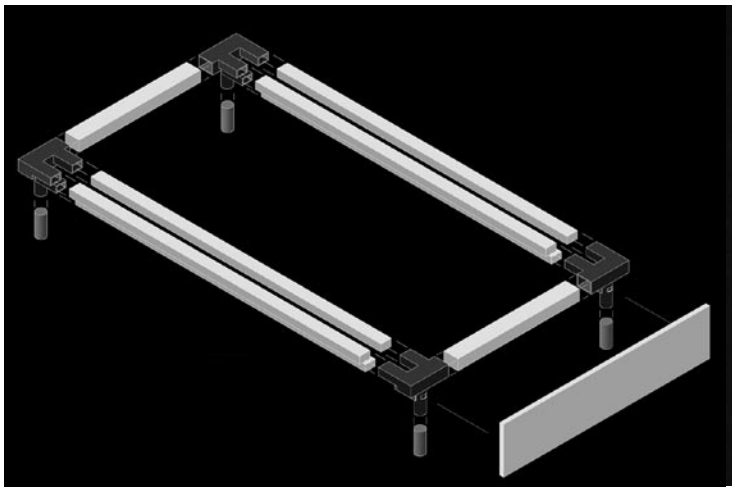

FIG 9
Possible reconstruction of the bed/couch frame.
Rendering by W. van Duivenvoorde, September 2009.

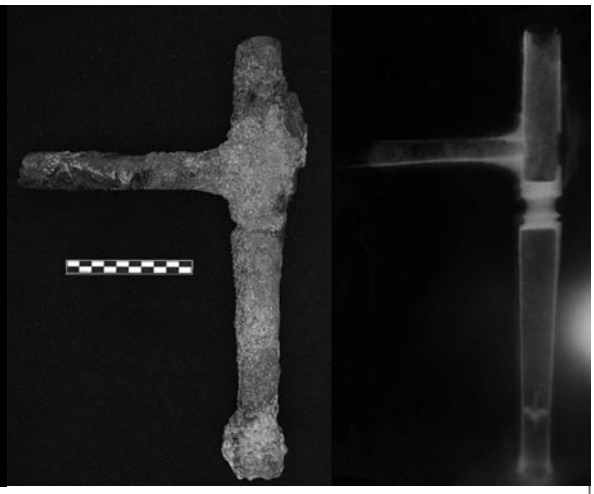

FIG 10
One of the concreted furniture legs (left) and its radiograph (right). December 2009.

and probably towards the end of the century. [33]

The other items are a complete Phoenician amphora that was broken in antiquity during the ship's wrecking, but which retains some of its original contents; an elegant ivory knife-handle with a long slot and rivets where the blade was attached (Figure 6); and a group of nine bronze objects comprising two sets of four pieces (Figure 7) and a single item. The elements of one set (Figure 7, bottom) have a vertical, cylindrical tube fixed perpendicularly and slightly off-centered to a hollow, rectangular segment. Three smaller rectangular tubes join to these at right angles; one to the cylindrical tube and two to the main rectangular piece, with only the flush end of the latter being closed (Figure 8).

A single, almost identical artifact resides now in the British Museum, having been obtained as part of a collection of supposed tomb furnishings from the Phoenician necropolis at Tharros, on Sardinia. The grave contents can be dated no more precisely than the 8th–3rd centuries BC, and the bronze object itself is interpreted as "part of a bed, wagon, or carrying-chair". [34]

The four pieces from our shipwreck would appear to be the corner elements of a bed or couch frame. The cylindrical tubes form the legs, while the rectangular pieces act as sockets to hold the connecting wooden or ivory beams that formed the frame (Figure 9). Slats of wood or ivory would have been laid across the beams to support a mattress or cushions. Furthermore, each of the legs has a small rectangular hole on its outer face, which likely served for attaching decorative carved ivory panels, for which Phoenician craftsmen were renowned.[35] The bed calls to mind Old Testament references to such luxurious furnishings, as in the warnings of Amos (6:4, 3:2) to the complacent of Israel, who "recline on beds of ivory and sprawl on their couches," lest they be "snatched away—with the corner of a bed and the cover of a couch!"; or in Solomon's "great throne of ivory", commissioned from Phoenician craftsmen (1 Kings 10:18; 2 Chron. 9:17). Opulent furniture is mentioned prominently as well in lists of booty taken and tribute received by Assyrian kings, as recorded in the their Annals: "ivory couches overlaid with gold" (§466); "tables of ivory, a bed of ivory and SHA-wood, ivory, chairs of ivory overlaid with silver and gold" (§475); "the rich furniture of his palace, ...beds of boxwood, chairs of boxwood, and tables of boxwood inlaid with ivory" (§476); "a couch of boxwood which was sumptuously inlaid, ...beds which were sumptuously inlaid, many tables of ivory and of boxwood" (§477); and "tables of SHA-wood, couches made of ivory and overlaid with gold" (§501).[36]

Cast bronze furniture pieces are known as well from ancient Urartu, in eastern Anatolia. Excavation at Toprakkale, in particular, has yielded an assortment of cast bronze furnishings dated to the seventh century BC. These include lion's paws and other decorative figural pieces, portions of a base-frame, and square-sectioned corner elements of a chair or throne that are similar to our bed fittings.[37] Another hollow-cast bronze furniture fitting in the British Museum is a lion-head terminal from the legs of a bed or chair, and comes from Egypt's Late Period, (seventh–fourth centuries BC).[38]

An especially intriguing set of grave furniture, contemporary to the wreck, comes from a local tomb in southern Spain in the necropolis of La Joya,

FIG 11
Bronze ornamental piece. Photograph by M. Polzer, August 2009.

near Huelva, dated 630–620 BC. The tomb contained a casket and support bed with bronze corner fittings joining ivory beams and ivory legs carved as Egyptian-styled men. The casket itself has bronze corner elements, two of which are fitted with silver hinges for the articulated ivory lid.[39]

This tomb also contained a mirror with ivory handle and ceramics similar to some found on our shipwreck. Another tomb in the same necropolis yielded a cylindrical stone object that is virtually identical to the pale green stone rod that we excavated in 2008; what we thought might be a whetstone.[40] Intriguingly, the tomb's excavator notes that the rod is "reminiscent of Baetylus idols".[41] Baetyli were sacred stones that represented a particular deity or, more precisely, the object in which the deity or spirit was believed to reside.[42] They were small stones, either naturally shaped or worked, that were believed to be animate, have oracular powers, and provide protection to their possessor.[43] Examples like the wreck object and that from La Joya may have been personal items of worship, used by their owners as aids to better channel their prayers in hopes of having them answered.[44]

The second set of bronze objects from the shipwreck consists of four concreted, T-shaped elements made from cylindrical tubes, the larger of which tapers in diameter (Figure 7, top). The objects resemble furniture legs, and may be those of a small chair, stool, or stand. Radiographs of the pieces reveal finely detailed leg moldings just below where the supporting crosspiece attaches, and would seem to confirm this supposition (Figure 10). They also reveal a rectangular hole in each leg, on the outer face directly opposite the crosspiece. As with the bed fittings, these holes probably accommodated the attachment of embellishing decorative elements.

The final bronze piece is a small ornamental fitting measuring approximately 16 cm long and 3 cm in diameter at its open end. The piece is hollow-cast from bronze in the shape of a right forearm with a clenched hand holding a lotus palmette (Figure 11). Lotus blooms, palmettes, and stylized versions of these motifs are common decorative symbols in Egyptian and Near Eastern art of the Bronze and Iron Ages, wherein kings, gods, and other exalted personages are often depicted with, or holding, stylized trees, flowers, or palm branches. The Phoenician version, demonstrated most often in their carved ivories, but equally applicable to their metalwork (as would seem to be the case here), is typified by a symmetric volute at the juncture of flower and stem.[45] Based on the other furniture elements with which our object was found, it too may be an ornamental fitting—part of an armrest, perhaps—for some piece of furniture. This may be confirmed by a pair of comparable, though larger, late-Roman chair ornaments fashioned in the shape of a forearm with hand grasping a cylinder topped by a stylized pomegranate.[46] Although made from silver and partially gilded, and incorporating different symbols, they are strikingly similar in design and potentially, in function as well.

Discussion

These objects are singular pieces fashioned of costlier materials, in contrast to the main portion of the ship's bulk cargo of raw materials, and have dramatically altered our perception of the wreck. It would not be unusual to find such objects listed in a registry of tributary goods, along with elephant tusks, lumber, copper, tin, and lead.[47] Does this mean, then, that the ship was engaged in tributary supply, perhaps as part of a fleet of such ships? If so, why then was it heading apparently northward before it sank? Such a route would seem more fitting for a vessel of one of the mercantile consortia from the settlements along the Mediterranean coast of Andalusia that dominated colonial trade networks in southeastern Spain and with indigenous centers in the interior.[48] The ship could have been en route to any number of commercial centers that dotted the eastern littoral. The trading port at La Fonteta (Guardamar), located at the mouth of the Segura River, lies

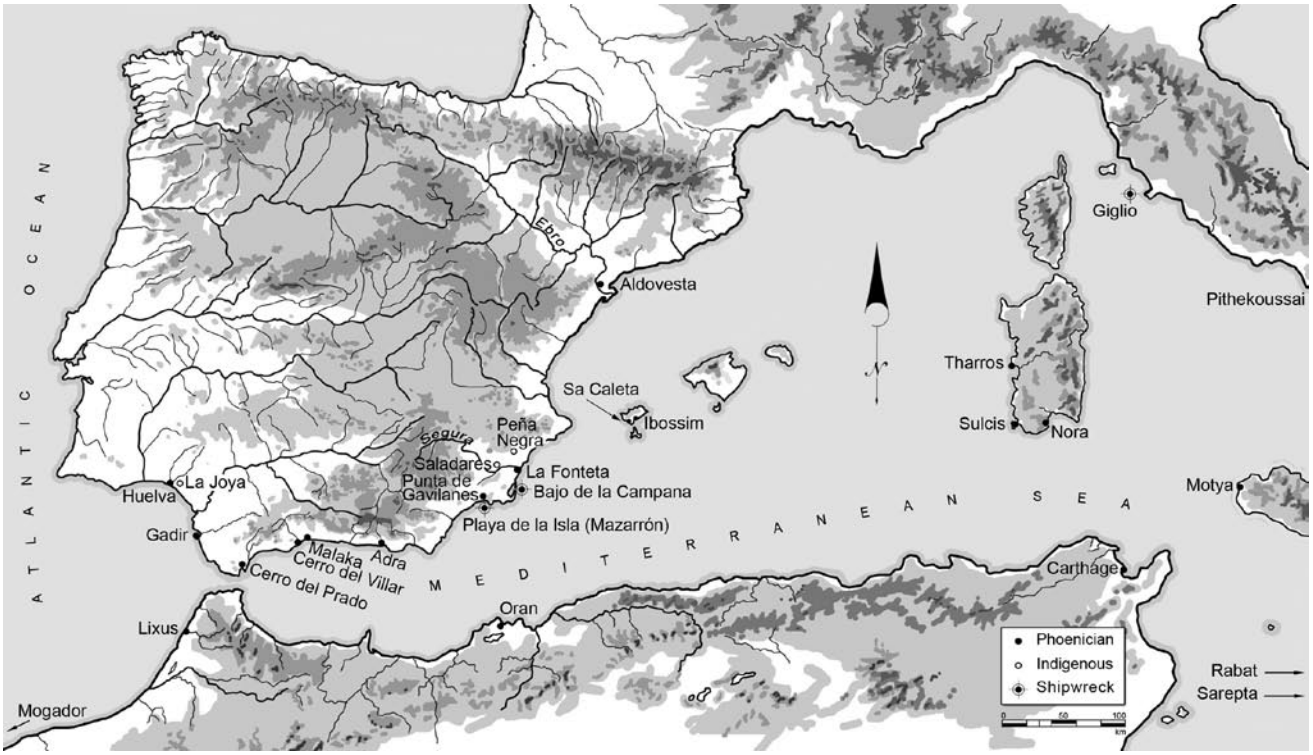

FIG 12
Map of Phoenician settlements in the central and western Mediterranean and other places mentioned in the text.

only a short distance from where the ship sank. The archaeological record attests as well to Phoenician activity in strategic indigenous townships: in the Alicante region, such as at Saladares and Peña Negra, where they established an industrial complex for the production of ceramics and exotic jewelry;[49] and, further north, in villages along the Ebro river valley. Of course, the ship's destination—whether immediate or ultimate—may have been the trading post of Sa Caleta on the island of Ibiza. Rapid commercialization of the entire eastern region, much of it focused on metal resources, including the recovery and treating of scrap metals, was well underway when our ship was plying the region's waters, and was predicated on the colonization of the Balearics in the late seventh century BC.[50]

That process was largely dependant on exchange with indigenous populations that controlled access to the metal deposits, agricultural resources, and strategic land routes in the hinterlands. Much of the ship's cargo, in particular its amphora contents (presumably wine or olive oil), ivory, wooden combs, and prestige objects, epitomized colonial trade with local populations; specifically such trade in Iberia and, regarding the latter objects, with the local elites.[51] The Phoenicians succeeded in creating a demand for such items, which they used to influence indigenous leadership (and, through them, the local populace) to help achieve their economic ambitions.[52] An intriguing observation regarding the prestige objects is that they all can have a possible funerary connection, and similar items have been found in Phoenician and indigenous tombs in Spain and elsewhere. This context could throw new light on two other wreck items found in close proximity, but excavated in 2008: namely, the fluted pedestal and stone rod.[53] Although we have not found whatever was meant to sit atop it, the pedestal could well have served as an altar or as a stand for a ceremonial basin. Its religious connotations are obvious, though, to our knowledge, no similar object has been found in any tomb, and it certainly is not part of the customary funerary offerings found in Phoenician graves.[54] Could this ship, then, have been carrying the accoutrements

for a burial, possibly for some local elite of the eastern region? While the number of amphoras found to date can hardly be considered a "cargo" of whatever product they contained, one certainly could envision them as grave offerings for someone of importance in the local leadership.[55]

The ship that sank at Bajo de la Campana did so at the height of Phoenician trade in the west, and in an area that was developing rapidly, both in terms of industrial exploitation of its own plentiful resources and as a distribution hub for goods from the Atlantic and southern regions of the peninsula to Phoenician colonies in the central Mediterranean.[56] Further excavation of this important shipwreck will surely help refine our understanding of this dynamic time and of the complexities of Phoenician dealings and relations with their indigenous partners in these activities.

Acknowledgements

We gratefully acknowledge the Region of Murcia for permitting this archaeological excavation and associated maritime operations. This season of fieldwork was made possible by a substantial grant from the Expeditions Council of the National Geographic Society and financial support from the Institute of Nautical Archaeology, INA directors Lucy Darden and Claude Duthuit, and David Hadley and the Fidelity Charitable Gift Fund. Mark Polzer's research of the excavated materials was funded in part by a generous grant from the Program for Cultural Cooperation between Spain's Ministry of Culture and U.S. Universities, and he wishes to thank especially INA General Council Jim Goold for his assistance in obtaining the grant. Our gratitude goes as well to Anthropology Department Head Donny Hamilton and Peter Fix with the Center for Maritime Archaeology and Conservation at Texas A&M University for logistical support and for providing travel grants to NAP students and team members Coral Eginton and Lindsey Thomas. Alberto Alvarez and Juan Carlos Amaya, of the Asociación Española Amigos de la Arqueología Subacuática in Cádiz, kindly supplied us with photographic and computer equipment to assist our work. Our friends and partners at the Museo Nacional de Arqueología Marítima and Centro Nacional de Investigaciones Arqueológicas Submarinas in Cartagena again provided archaeological and logistical support. We especially want to acknowledge the dedication of Milagros Buendía Ortuño, who is overseeing conservation of the myriad materials we have raised, and who assisted us as well in the field. Miguel Ángel Garcia Gallego and Javier Garcia Gallego documented a good portion of our underwater work with photographs and video. Finally, we extend heartfelt thanks to all of our excellent team members—especially our boat captain Pedro Angel Sanchez Conesa—who toiled tirelessly and without complaint despite the trying circumstances under which they often had to work.

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Notes

1 Mas García 1985, 153–71; Roldán Bernal et al. 1995; Polzer and Pinedo 2007; Polzer and Pinedo 2008.

2 For a plan of the site, see Polzer and Pinedo 2008, 6 fig. 2.

3 Polzer and Pinedo 2008, 6 fig. 2, sectors D0–G5.

4 See Polzer and Pinedo 2008, 8.

5 See Polzer and Pinedo 2007, 58; Polzer and Pinedo 2008, 9. Such combs are typically made of boxwood, which is quite strong and does not split easily when carving and sawing the delicate teeth (Davidson 1952, 179, n. 1). Two elaborately carved examples, one of ebony wood and another of ivory, reside in the Louvre (Gehrig and Niemeyer 1990, 133–4), and the Hispanic Society of America has in its collection of Phoenician ivories several ornate combs (Bonsor 1928).

6 These include 76 tin ingots and two of copper, more than 4,000 nuggets of galena (with a marked increase in the number of larger nuggets), and nine elephant tusks, as well as pinecone scales, pieces of dunnage, and a number of large, round ballast stones.

7 Pritchard 1971, 17–19, 21.

8 López Malax-Echeverría 2006, 80–1. As evidenced by examples from Tharros, Sardinia, now in the British Museum, the two-nozzle lamp continued in use until at least the third century BC (see Bailey 1962, 38–9, pl. 6, nos. 1–11).

9 Vuillemot 1965, 65; Roldán Bernal et al. 1995, 13, 16–19. For a discussion of the varying terminology of this type, see Docter 1999, 487 n. 19.

10 Mas García 1985, 156–7, fig. 3, no. 1; Roldán Bernal et al. 1995, 14, 19–21; Ramón Carbonell 1986, 103.

11 Ramón Torres 1995, map 108; Roldán Bernal et al. 1995, 18–19.

12 Mederos Martín and Ruiz Cabrero 2004, 266; Roldán Bernal et al. 1995, 16–17; Guerrero Ayuso and Roldán Bernal 1992, 184.

13 Docter and Annis 1997, map 8.

14 Aubet 2001, 285, 321; Roldán Bernal et al. 1995, 17;

Docter 1999, 487.
[15] Celestino Pérez and Blánquez Pérez 2007. See also Aubet 2001, 287; Roldán Bernal et al. 1995, 18.
[16] Bartoloni 1988, 33; Gras 1985, 292–4.
[17] Roldán Bernal et al. 1995, 19–21.
[18] Mederos Martín and Ruiz Cabrero 2004, 268; Roldán Bernal et al. 1995, 19–21; Bartoloni 1988, 33; Gras 1985, 292–4.
[19] Roldán Bernal et al. 1995, 20; Bartoloni 1988, 33; Ramón Carbonell 1986; Gras 1985, 295.
[20] Similar material is referred to varyingly as resin, pitch, or tar, all of which are derived from coniferous plants. Resin is the natural secretion obtained by tapping pine trees or other conifers, while pitch—what the ancients called pix (*NH* 16.22)—and tar are produced by heating resin and dead wood, respectively (Loewen 2005, 238–9; Beck et al. 1989).
[21] Parker 1992, 19.
[22] Pulak 1998, 201; Mills and White 1989.
[23] Bound 1985, 51; Eiseman and Ridgway 1987, 3 n. 2.
[24] See, e.g., Dupont 1998, 182 n. 257; Beck et al. 1989, 379.
[25] Lucas 1948, 27–9; and for ancient discussion of this practice, see Pliny *NH* 14.24 and 16.22.
[26] Casson 1995, 212 n. 47; and see 211–2 for additional references by ancient authors to pine tar, wax, paints and other paying materials. For studies of hull coatings from ancient ships, see Connan and Nissenbaum 2003; Connan et al. 2000; Beck and Borromeo 1990; Mills and White 1989.
[27] The territory of Cerro del Villar, on the Mediterranean coast of Andalusia, for example, had high-quality clays that were exploited by Phoenician potteries (Aubet 2001, 324).
[28] Barnett et al. 2006.
[29] Aubet 2001, 288; Maaß-Lindemann 1999, 130; Culican 1970, 6, who suggests that they may also have been used for lamp oil.
[30] Maaß-Lindemann 1999, 130; Culican 1970, 10.
[31] Aubet 2001, 288.
[32] Maaß-Lindemann 1999, 130–1; Culican 1970, 6. Bottles of this type found at Peña Negra, near Alicante, have all come from level IIB, which is dated 600–550/535 BC (González Prats 1986, 288).
[33] Based on similar bottles found in tombs at Rabat (Malta), Nora (Sardinia), and Peña Negra (Baldacchino and Dunbabin 1953, 36 fig. 4, D3; Patroni 1904, 168 fig. 19; and González Prats 1986, 286 fig. 4, respectively; Culican 1970, 7).
[34] Barnett and Mendleson 1987, 154 (Tomb 7, 7/45), 155 fig. 22 (7/45), pl. 87 (Tomb 7, 7/45). For the difficulties in dating the objects from Tharros acquired by the British Museum, see Bailey 1962, 36–8.
[35] Winter 1976, 1; and see, e.g., the ivories from Nimrud, of which those from the NW palace of Ashurnasirpal Barnett (1935, 184–5) attributes to a sumptuous couch, and likely a ritual couch, similar to a Roman pulvinar, associated with Ishtar (Phoenician Ashtart).
[36] Luckenbill 1989.
[37] Merhav 1991, 250–61, especially 254–5 fig. 7, 259 no. 5, and 261 no. 8a.
[38] BM 67043.
[39] Garrido Roiz and Orta García 1978, 106–10, figs. 65–7 and pls. LXXI–LXXII, 1.
[40] Polzer and Pinedo 2008, 9.
[41] Garrido Roiz and Orta García 1978, 140 fig. 88, 143, pls. LXXX.2, XCVII.1.
[42] *NH* 17.9; Photius, Cod. 242. The name Baetyli is a compound word of Phoenician origin—*Bait-yl*—and means a thing in which a supernatural power or being resides (Moore 1903, 203). In Phoenician mythology, Baetyli were believed to be stones created and endowed with souls by Uranus (Eusebius, *Praep. Evang.* 1.10) and, thus, Baetylus personified is a son of Uranus and Ge, and a brother of El, Dagon, and Astarte. Whether these stones were associated specifically with the cult of Baetylus is uncertain.
[43] Moore 1903, 203. The stones were believed to have fallen from the heavens (i.e., were meteorites), though undoubtedly not all were. Most were probably prehistoric stone implements such as axes, hammers, and mace heads (Moore 1903, 204). The Diopet of Ephesus is one example; it measures 15.2 cm in length and is made of a dull green stone (possibly chloritic schist), being facetted and inlaid with tin (Oakley 1971, 207–9; Cook 1940, 898–900, pl. lxvii and fig. 731). Worship of such stones was common among the peoples of the Levant, specifically Phoenicians and Hebrews, as well as the Greeks (Smith 1867, 453), and many sacred stones were reported to be found in the region of Lebanon, i.e., Phoenicia (Photius, Cod. 242). Baetyli were distinct from other sacred stones, or omphaloi, which were larger and typically shaped as cones or pyramids, tapered cylinders with beveled tops, pillars, obelisks, etc. (Moore 1903, 200, 205; Falconnet 1722, 523).
[44] The rubbing marks visible on the wreck piece could well be the result of such use.
[45] Winter 1976, 6, 16 and, for illustrated examples, pls. Ia, IIIa, IVb, and VIa and b.
[46] BM 1866, 1229.20; Dalton 1901, 76 nos. 336–7; Shelton 1981, 34.
[47] Aubet 2001, 55; Luckenbill 1989,§§466, 475, 476, 477, 479, etc.
[48] Aubet 2001, 336.
[49] González Prats 1986; Aubet 2001, 340. This would seem to be a likely destination for the ship's ceramic and earthen cargoes. Although pottery was being produced locally by the end of the seventh century BC, the area maintained a continuous import of assorted ceramics from south-coast workshops near Málaga (González Prats 1986, 299).

[50] Aubet 2001, 339–41.
[51] Aubet 2001, 287–9, 315–7 for oil and wine production along the coast of Andalusia.
[52] Aubet 2001, 288–9.
[53] The pedestal was originally interpreted as a possible shipboard item used in maritime ceremonial practices, and the stone rod, as previously discussed, as a whetstone (Polzer 2008, 7–8).
[54] Aubet 2001, 330.
[55] Aubet 2001, 289.
[56] Aubet 2001, 341.


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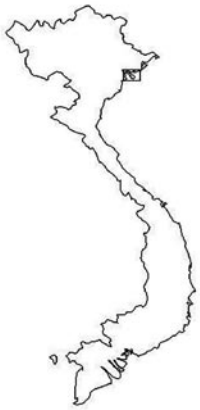
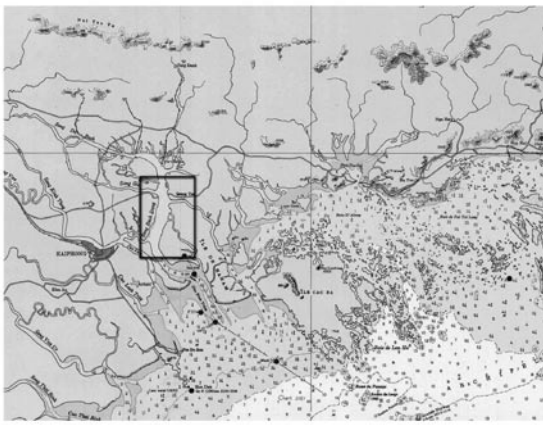
The Bạch Đằng Battle Site Survey Project 2009

A map of Vietnam and close up of the region showing the research area.

Introduction

The battles fought at Bạch Đằng River signify the strength of Vietnam as an independent nation; this is where the Vietnamese resistance forces repelled an invading enemy not once but twice, in the 10th century against the Chinese dominance and in 1288 against the Mongolian fleet sent by the emperor Kublai Khan. Both battles employed the strategy of secretly planting large wooden stakes along the riverbed and then luring in the enemy's fleet. When the tide ebbed, the enemy suddenly found their ships impaled on the stakes and were attacked by the Vietnamese army hiding in ambush. Both generals who led the Vietnamese forces into victory, Ngô Quyền in the 10th century, and Trần Hưng Đạo in the 13th century, are remembered as the country's greatest heroes and continue to be worshipped to this day. The cult of "Saint" Trần Hưng Đạo is especially strong such that almost every village in Vietnam has a shrine or a temple dedicated to worship his spirit. Historical accounts from the battle of 1288 recount that the enemy's fleet

A team conducting visual survey of the land. Photograph by R. Sasaki.

of more than 400 ships was destroyed near the mouth of the Bạch Đằng River, right before reaching the safety of open water as they were retreating from the capital. In the 1950s, some of these wooden stakes were found along the edge of the Bạch Đằng River near the town of Yên Giang in Quảng Ninh Province. The region is a famous center for Trần Hưng Đạo's worship and the local tradition indicates that the battle took place here. Vietnamese archaeologists conducted several excavations and surveys to determine the age of the stake yard at Yên Giang and deducted the stakes were indeed related to the invasion based on the Carbon-14 analysis of the wood. Some of these stakes are now displayed in museums across Vietnam, attracting numerous tourists. Despite the potential of a great discovery, neither detailed reconstruction of the battle sites have been made, nor any artifacts related to the invasions been discovered, save for those stakes.

Activities Conducted

Members from Texas A&M University and Flinders University (Adelaide) visited the site in 2008 and assessed the potential of conducting an archaeological survey in revealing the history of the battle of Bạch Đằng. In 2009, two weeks' survey in spring was conducted with the collaboration of the Vietnamese Institute of Archaeology at Hanoi and was fully supported by the National Geographic Society/Waitt Institute for Discovery. The aim of the survey was to identify areas that would possibly contain cultural remains from the battle of 1288 as well as to understand the battle strategy. This is a first phase of research, combining historical, archaeological, and ethnographical approaches.

The main objectives of the projects were 1) to reconstruct the landscape relative to the period of the historical battles, 2) to map the distribution of the identified wooden stake yards around the Bạch Đằng River, and 3) to synthesize all data collected to identify areas with high probability of finding shipwrecks. To achieve these goals, the team realized the importance of recording historical monuments related to the invasion and of recording oral and documented history. Furthermore, identifying natural obstacles on land as well as in water that may have existed in the past, and of mapping the area where stakes were located through visual survey and interviews. All data

The official stake yard of Bãi cọc Yên Giang. Photograph by R. Sasaki.

The temple of Vua Bà. Photograph by R. Sasaki.

were collected using Global Positioning Systems (GPS) and interviews were recorded digitally. The team visited all major monuments related to Trần Hưng Đạo and several other significant buildings and community houses in the region. The worship of "Saint" Trần is ubiquitous all over the country; it is believed that more than three hundred temples and shrines are dedicated to him. Some oral traditions regarding a particular monument may be related to an actual historical event. Many of these cultural monuments were, however, later established as centers for worship and the oral traditions may have become a myth developed hundreds of years after the battle. Thus, the stories told by the local residents must be studied carefully to separate myth from reality; these living traditions play a major role in people's lives even today. Interviews were also conducted to gather more information about the topography of the area, locations of stake yards, as well as to gain further knowledge of the cult of Trần Hưng Đạo. During the interviews, the team was provided with ceramics fragments that local residents collected in the past. Some of these ceramic fragments were recorded. The reconstruction of the former landscape was also planned and therefore the team visually surveyed on land and interviewed residents to glean any clues relating to the past landscape. It was also important to understand the waterways and the nature of the islands. The team inspected navigational hazards located on the Bạch Đằng and Chanh rivers. Some team members visited the rocky island in the Chanh River (Ghềnh Chanh) using a traditional bamboo basket craft to experience the integration of the rivers and the islands in the landscape. We also visited nearby islands to search for any indication of the battles (isolated stakes).

Through interviews and visual surveys, the team acquired information of several new possible stake yards. The positions and general characteristics of these stakes were recorded. The Institute of Archaeology at Hanoi provided reports, photographs, and maps from the previous excavations conducted at two Bạch Đằng stake yards; Bãi cọc Yên Giang and Đồng Vạn Muối. Once in the field, precise positions of the previously excavated stake yards were determined using GPS. A simple recording of the stakes was conducted and the levels of preservation of the stakes were assessed. The team recommended initiating the process of preserving these wooden stakes to

top to bottom

The entrance of the Den Trung Coc, located in Nam Hòa. Photograph by R. Sasaki.

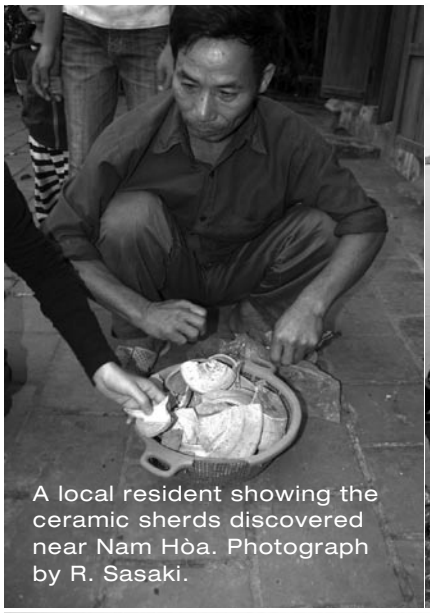
The paper doll army used for a ceremony at the Kiếp Bạc temple. Photograph by R. Sasaki.

Dr. Lê Thi Lien conducting interviews with the local residents. Photograph by G. Belcher.

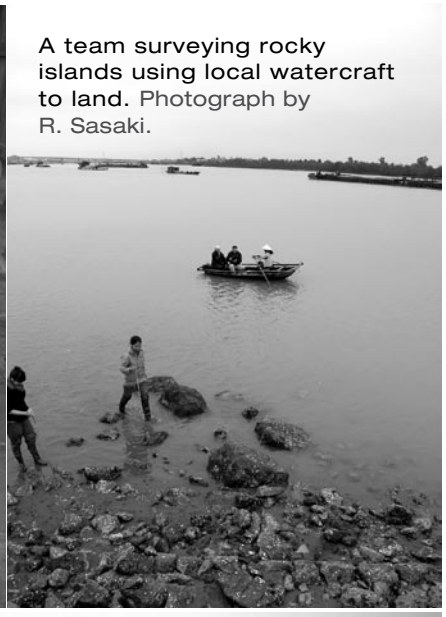
the local government officials because the remains are exposed to air and may deteriorate over time. The exact method of preserving the site is currently being discussed with the authorities. A new concentration of stakes was found at Đồng Má Ngựa, at the southern end of the research area, when a local resident was digging a fishpond. The discovery was reported to the local authority. The team was asked by the Institute of Archaeology at Hanoi to excavate, record, and discuss the possible method of preserving this newly identified site.

Results—*Cultural Monuments*

There are numerous monuments and temples in the area, many of which possess a rich history rife with religious and cultural significance. With the assistance of the local cultural heritage and tourist office, the team recorded the oral history and the historical significance of these cultural markers. More than a dozen locations were recorded during the survey. Many of the historical sites and temples date to the 15th century or later. Others commemorate Trần Hưng Đạo. Surprisingly, little evidence of commemoration of the battle of the 10th century was found. These temples and places of worship were usually located on higher ground where the area was possibly occupied at the time of the battle. The landscape has changed



A local resident showing the ceramic sherds discovered near Nam Hòa. Photograph by R. Sasaki.



A team surveying rocky islands using local watercraft to land. Photograph by R. Sasaki.

A rocky shoal in the Chanh River. Photograph by R. Sasaki.

since the 13th century, and the areas near the monuments are now considered possible islands and sandbanks at the time of the battles where no remains of stakes or ships can be expected. Instead, these areas are now considered probable natural hazards and obstacles utilized as part of the Vietnamese strategy. This is the most complex understanding of the battle site that has ever been known and fits well into Vietnamese military tradition and strategy. Below are summaries of the significant locations recorded during the survey.

Temple of Trần Hưng Đạo and the Temple of Vua Bà—Possibly the largest temple in the area, the temple of Trần Hưng Đạo is located near the northern edge of the research area along the Bạch Đằng River. Through interviews with the local residents, it appeared that this current temple does not stand at its original location but that it was moved in the past. The team identified the possible original location of the temple, but no conclusive evidence was found. There were only some remains of foundations that appeared to belong to a recent structure, and some ceramics were scattered on the surface. This location north of the Yên Giang district may have been near the original shoreline in the 13th century.

The Vua Bà Temple, a smaller temple located behind the present Trần Hưng Đạo temple complex, is associated with an old lady, or a possible goddess. Legend tells that she instructed Trần Hưng Đạo on locations to plant the stakes, timing of the tides, and other strategies for the attack. He followed her instructions, leading the Vietnamese to victory. The general later returned to locate this old lady but she had disappeared. Realizing that she was a goddess, he built a temple in her honor. It is believed that the location marked the edge of the river at the time of invasion. However, the team was not able to determine the original location of this small temple. Perhaps it has always been associated with the temple of Trần Hưng Đạo, or perhaps the current location may be the original location.

Den Trung Coc—This temple is located in Nam Hòa commune, just east of the Đồng Vạn Muối stake yard (previously excavated by the Vietnamese Institute of Archaeology). According to a legend, while Trần Hưng Đạo was building the stake yards at the mouth of the river, his boat struck a muddy shoal and was immobilized. He called for help and local fishermen hauled his boat off the shoal. Trần Hưng Đạo later built a temple near that location. Although the temple has been rebuilt in the past, it is believed that the temple has not moved since the 13th century. The story does make sense and seems to be supported by some topographical evidence. The Nam Hòa commune is located on slightly higher ground and would likely have been a muddy shoal in the past.

Kiếp Bạc—The Kiếp Bạc temple is located 80 km south of Hanoi in Hai Duong province. It is located in a region where Trần Hưng Đạo retired after his service in the military and it is said that he lived in the area until his death in 1300. The actual tomb of Trần Hưng Đạo has been kept a secret and the temple of Kiếp Bạc was built to honor to his soul and his family. Every year, the Kiếp Bạc temple hosts a festival to commemorate Trần Hưng Đạo's death. Even when there is no festival, many visit the temple to make offerings to his spirit, and a form of elaborate rituals and ceremony can regularly be seen.

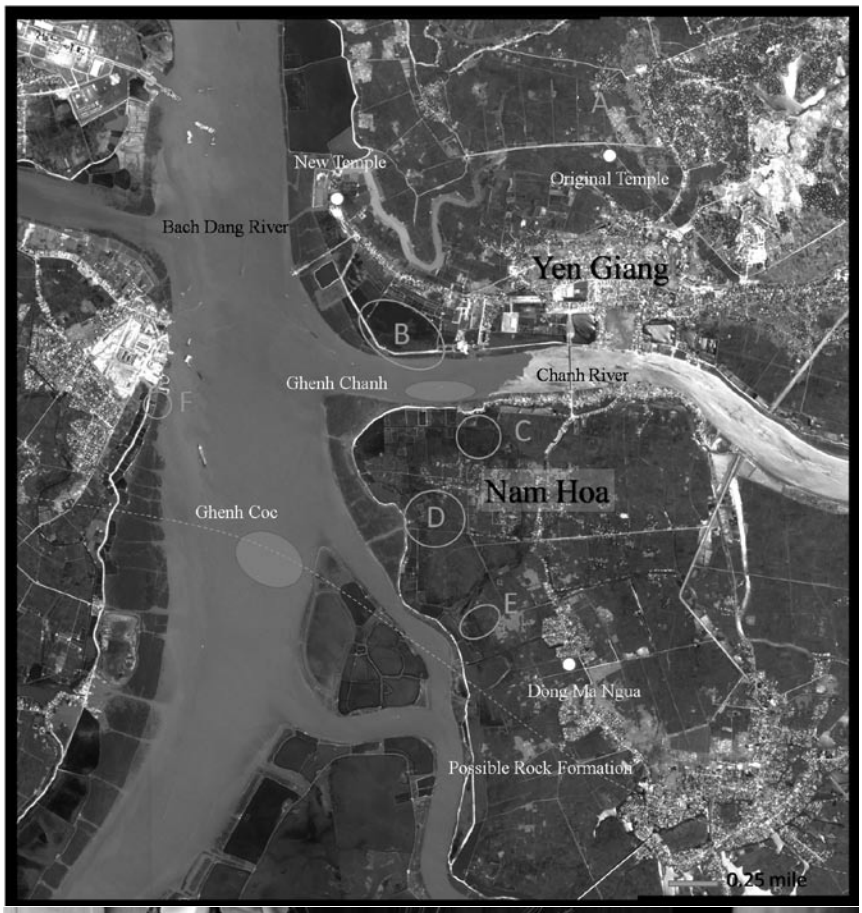
Natural Barriers/Reconstructing the Ancient Topography

To understand the strategy of Trần Hưng Đạo it is essential to acquire a deeper understanding of the natural landscape. To efficiently block the Mongolian fleet, the Vietnamese army had to barricade a large area, which

puzzled historians as it is an area of more than 2 miles long. Various hypotheses were formulated, such as massive walls of stakes in a single line. Looking at the present day landscape on a map does not answer any questions. However, through extensive interviews and by studying the topography on the ground, it became apparent that the area was a large estuary in the past. The area was dotted with small islands and shoals, not resembling the modern landscape dominated by rice paddies and villages. After the construction of a series of dikes in the 1950's, rice fields were developed, covering the ancient site of the battle. It is most logical to assume that the Vietnamese used the islands, shoals, and other natural shipping hazards combined with areas of stakes to create a defensive "wall." This survey was successful in identifying the natural obstacles that existed in 1288.

Yên Giang and Quảng Yên Communes—The Yên Giang and Quảng Yên are the largest communities in the region today and were likely on islands in the past. Evidence attesting to the fact this area was on dry land is the presence of Cay Lim, or Iron Trees. According to legend, the Vietnamese used these iron trees in the area to make the stakes. Today, only a small number of these trees remain in the area; it is said that they date to the 13th century. It is also noteworthy that the area could have been a well suited to hiding troops in ambush.

Nam Hòa Commune and Duong Ba Thu Gung—A high earthen mound is located in Nam Hòa commune, just north of Den Trung Coc. Today, a small temple and many tombs are built on the mound. We were told that this earthen mound was extensive in the past, but that most of the higher areas were leveled for rice fields. Local residents presented us with several broken ceramics they found while ploughing their fields. These ceramics date roughly from 200 BC–AD 200, attesting to



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A satelite/aerial photo of the research area showing important monuments, communes, sites, and stake yards.

A local basket maker who informed about the presence of a possible stake yard (A). Photograph by G. Belcher.

above
The site (fish pond) of Đồng Má Ngựa. Photograph by R. Sasaki.

right
One of the stakes found at Đồng Má Ngựa. Photograph by R. Sasaki.

the use of the island for over a millennium (although it may not have been occupied continuously). The villagers reported that during a past flood event, people gathered around the Nam Hòa commune because this area remained dry. We were told that a boat as long as 10 m or more in length was able to moor near the temple.

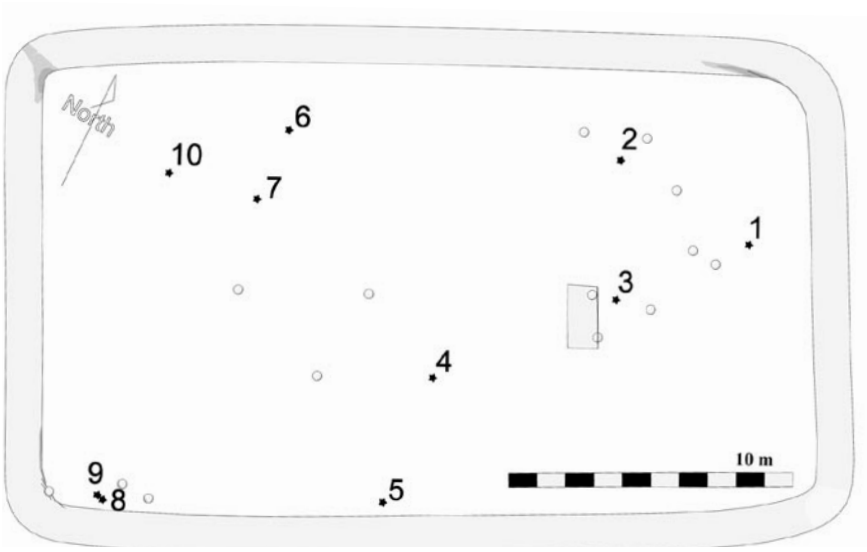
Survey of Waterways—A survey of the waterway was conducted to gain a better understanding of the river-system of the area. The local residents informed us that both the Bạch Đằng and the Chanh rivers were rocky in some areas and often it was not possible to navigate freely during low tides. The Chanh River in Vietnamese means "Rocky River." During the French occupation and in more recent times, many of these rocks were destroyed and removed by dynamite, in order to open a deeper, safer passage through the rivers. Navigation charts from the 1960's show a complex underwater topography that suggests the location of the blasted and partially removed navigational hazards. Today, several channel markers erected on concrete islands can be seen in the area. This narrow rocky formation extends from southeast to northwest, running across the full length of the Bạch Đằng River. The team used shallow draft, traditional bamboo boats to land on one of the islands on the Chanh River. The surface was covered with boulders and rocks, perhaps removed from the riverbed and piled up aside. These islands suggest that these hazardous rocky shoals and islands were available for use as part of the "wall" to block the river in the past.

Extension of Rock Formation—The rock formation across the Bạch Đằng River extends further east, and the same type of rocks is visible on land in the south of Nam Hòa commune. We were told by one resident that during extreme low tides he was able to walk across from the area just south of Đồng Vạn Muốito Bãi Nhà Mạc island. Large piles of rocks can be seen dotted throughout the otherwise flat rice fields. Local residents used these rocks to build houses and other structures. A canal was intended to be built in the past along the border of Nam Hòa and Yen Hai communes, connecting the Bạch Đằng River to the center of Nam Hòa; however, it was too difficult to dig through the rocks, and the plan was abandoned. A new canal was built later to the north and is now in use. These rocky areas were likely to stand as another navigational hazard present in 1288, and perhaps delineate the southern extent of the stakes because no stakes have been found south of the rock formation.

Stake Yards

The main focus of the project was to identify the distribution pattern of the stake yards and to determine the strategy that Trần Hưng Đạo used to block the Mongolian fleet. As previously described, it became clear that Vietnamese forces in 1288 utilized their knowledge of the complex topography and merged concentrated areas of stakes with natural navigational hazards to efficiently block, trap, and destroy the invading Armada. The location of the stakes plotted during this phase of the project confirms this new understanding of Trần Hưng Đạo's strategy—most of the stake yards we identified lie between these "natural walls." The project was successful in locating several concentrations of stakes that were not previously known or recorded. During the survey, we focused on identifying the main concentration of stakes, but not enough time was available to record individual stakes. What follows is a brief summary for each of the concentrations of stakes, or "stake yards." The stake yards are designated with Roman letters in sequence from north to south.

Stake Yard A: *(previously unknown)*—Information of this possible stake yard, which is located north of the Yên Giang commune, was provided by a local resident, who said his father used to find stakes around the field. Back then, the residents did not know what these were, and all of the stakes were burnt as firewood or used in constructions. The survey team was not able to visually confirm the presence of a stake yard. According to informants,



A site plan of Đồng Má Ngựa with a boundary of a fish pond, identified stakes (star), and 1x2 m test pit. Small circles indicate locations where possible stakes were identified but were not excavated to ensure a better preservation of the site.

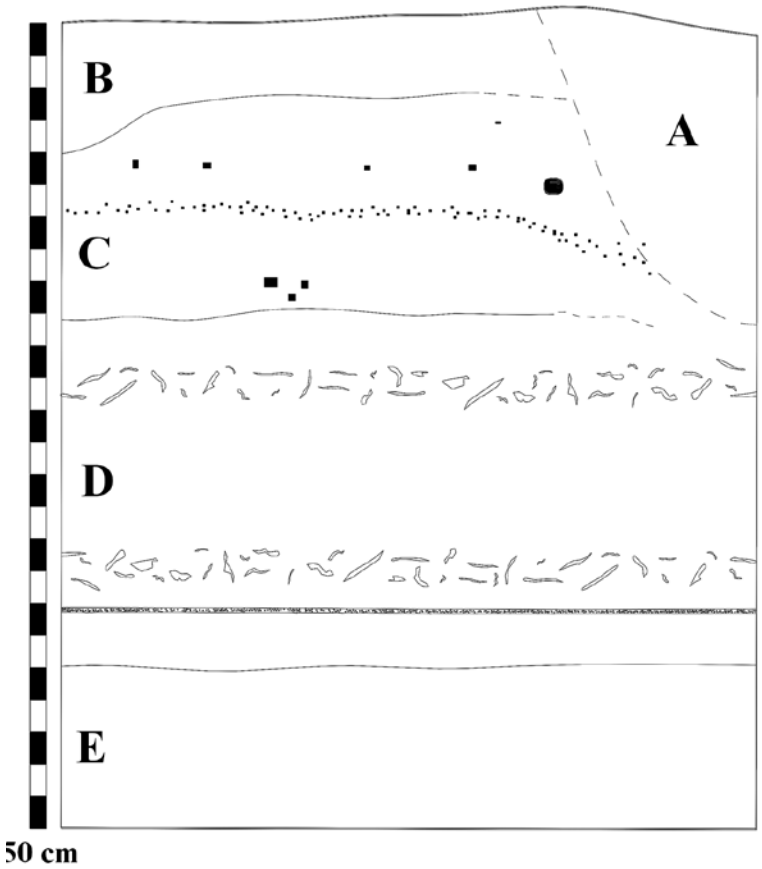
	Shape	Diameter/ dimension	Length	Angle/tilt	Direction
1	Circular	14 cm	35 cm	30	West
2	Hexagonal	9 cm	30 cm	0	0
3	Circular?	10 cm	25 cm	30	West
4	Rectangular	10x9 cm	33 cm	0	0
5	Rectangular	13x9 cm	23 cm	0	0
6	Circular	23 cm	30 cm	30	West
7	Na	12x6 cm	20 cm	0	Nw
8	Na	15x15 cm	Na	Na	West
9	Na	18x18 cm	Na	Na	West
10	Rectangular	15x15 cm	45 cm	10	North

the stakes in the area were narrow and long, perhaps more than 3 m in length. Perhaps, this particular waterway was narrow at this location, nonetheless. It is possible that it was part of the "wall" that the Vietnamese had to create. It is interesting to note that the area is close to the original location of Trần Hưng Đạo's temple; this stake yard may represent the northern end of the final battle ground.

Stake Yard B: *Around Bãi cọc Yên Giang* (previously excavated)—The official stake yard of Yên Giang is protected from further development and tourists freely visit this archaeological site. The excavation report is available in Vietnamese, and for this, the team did not dedicate time to record these stakes again in detail. The stakes in the protected area seem to be randomly placed. The team conducted interviews and discovered that many people in the area found more stakes in the past, but most of these were removed and can no longer be located. They remembered that the stakes were often found in a cluster and were parted 0.9–1 m from each other. There is no report of stakes (or artifacts) found in the rivers. According to their memories, some stakes were rectangular and others were rounded. An informant remembered the area where he found the stakes was called Đầm Nhử (ambush area). We could not identify its exact location, but believe it to be north of the official stake yard, perhaps closer to the new Temple of Trần Hưng Đạo.

Stake Yard C: *South of Chanh River (previously unknown)*—This is the area between Chanh River and Nam Hòa commune. Although the possible discovery of a stake yard in the area was previously suggested by Vietnamese archaeologists, this was the first time that such a discovery was reported. Local residents informed us that several stakes were discovered in the past in the area. The exact number and locations of the stakes are not yet documented and may never be known because it seems that most of the stakes have been removed and the remaining stakes could not be visually located.

Stake Yard D: ***Đồng Vạn Muối (previously excavated)***—This was the second stake yard to be excavated by Vietnamese archaeologists in 2005. This stake yard appears to cover a wide area. As with Bãi cọc Yên Giang, the excavation reports are available in Vietnamese and are being translated into English for this project. Residents are informed by the government not to remove any of the stakes that may be found in their property, and thus numerous stakes can still be observed



A soil profile of 1 x 2 m test pit.

A–Disturbance from a stake.

B–Clay/sand disturbance.

C–Mainly clay layer with some charcoal deposits.

D–Clay and sand layer with deposits of marine shells.

E–Compacted layer of sand.

dotted throughout the rice fields. There seems to be no clear distribution pattern; perhaps because an unknown number of stakes was removed in the past. The local authority is currently discussing ways to preserve the site and make it accessible to the public. Currently, the stakes are buried and protected from further erosion. One interesting note is that during flooding events in the past, this area was completely submerged under water. This suggests that the area could have been a deep channel in the past, making it necessary to place stakes to block the passageway for the Mongols.

Stake Yard E: *Southwest of Nam Hòa (previously unknown)*—This is the area southwest of Nam Hòa. The relationship between natural barriers and stake yards is not yet completely clear in this area. The presence of an ancient river channel has been suggested by a local historian. And such a trace can also be seen on an aerial map. The team was informed that "someone" had seen multiple stakes exposed after a major flooding event in the 1950s in the area. We were told that there are hundreds of stakes buried under 5 meters or more of silt. It is certain that more information will come to light in the future as local residents are now more sensitive to the significance of the stakes. The team did find several isolated stakes, but cannot yet confirm that they were related to the battle.

Stake Yard F: *The opposite shore (Previously unknown)*—A visual survey and interviews with the local residents on the opposite shore of the Bạch Đằng River were also conducted. This area has seen a major land-reclamation and dredging operations that destroyed the ancient landscape. The local residents informed the team that several stakes may have been seen in some pocket of original land that escaped the modern construction projects. The presence of a stake yard is not confirmed, and thus a further survey in the area may be necessary.

Excavation at Đồng Má Ngựa

A new stake yard was discovered at Đồng Má Ngựa where a local resident found numerous stakes while digging a fishpond. We were asked by the cultural officials to map the site as well as to excavate a small area to analyze the soil profile where the stakes are buried. At first, the team recorded the location of the exposed stakes. A total of 22 stakes were observed and mapped using a Total Station. The distribution pattern of these stakes is random. With such a small sample of stakes, no conclusive remarks can be made, however, many of the stakes were tilted towards the north and northwest, up river and in the direction from which the Mongolian

A team photograph at the local municipal office building.

fleet was approaching. Secondly, a small trench excavation (1 m x 2 m) was conducted, digging down to a depth of approximately 3 m from the surface of the fishpond. At the end of the survey, five wood samples of isolated stakes were collected for species identification and C14 analysis. It must be taken into consideration that the result of this excavation and recording only represents a small percentage of a much larger battle-site. Thus, the result of this particular site may not apply directly to the entire research area. Nevertheless, it can be used to understand the general trend of the stake yards and sediment characteristics of the area. Overall, the result showed several promises for the future project.

A large majority of the stakes shows a remarkable preservation state and appear almost new. It must be stressed that not only the individual stakes, but also a section of a battlefield and associated artifacts may be well-preserved in such good conditions. The profile of the 1 m x 2 m trench showed several buried layers indicating that a series of depositional events took place in the past. The profile exhibited a deep deposit of clay overlaying the deposit of sand, suggesting an estuary or a shallow river when the stakes were placed. More recent depositional events appear to have occurred at a relatively fast pace ensuring excellent preservation of organic materials. According to the result of species identification, it was apparent that not all stakes were made of the same wood species. Of five wood samples, three samples were identified as Shorea-Shorea (Dipterocarpaceae), and two are not yet identified. The result of C14 analysis provide dates that are in accordance with our expectations, or slightly younger in age. With a geoarchaeology specialist in the field for the next season, combined with the observations made during this season, a detailed reconstruction of the past environment is possible.

Further Plans

This season's preliminary survey enabled us to identify possible locations for searching potential shipwrecks. At the same time, it is essential that a geoarchaeological survey be conducted. The topography played an important role in determining where the stakes could have been placed, and it is a crucial aspect in the next phase of the survey to fully understand the changes in the local environment. Systematic core sediment samplings should be conducted to document the proposed and reconstructed

landscape of the past. In addition to landscape reconstruction, a gradiometer survey is planned. Heavy accumulation of silt created a possible well-preserved site. Furthermore, the area has not seen much development, and interferences from modern trash and structures are minimal. Hence, weapons and concentration of nails that were used to build a hull may be found using remote sensing technology.

Summary

Considering the short time-frame of the project, this survey was a great success. The survey team achieved most of its original goals, and more significantly, accomplished more than what was originally planned. During the survey, it appeared clearly that the ancient topography of the battle-field must be generated to understand the military strategy of Trần Hưng Đạo. Through the interviews and surveys, a deeper and more complex understanding of the past topography became apparent. The Vietnamese used an elaborate strategy reliant on "local knowledge" that the stakes should be placed between the natural obstacles formed by higher ground, possible marsh-lands, and rocky areas to create an efficient "defensive wall" to trap and defeat the Mongolian fleet. With this strategy, they destroyed the world's largest navy at the time. The efficient, ingenious, and creative use of the landscape in defending their territory is one of the characteristics of Vietnamese strategy that continues even strongly into the era of modern warfare. The most notable example of the efficiency in creating the "wall" was seen in the area from Bãi cọc Yên Giang to Đồng Vạn Muối, where we observed stake yards placed between natural hazards and running in a continuous line. No stakes were found south of the rocky formation during this survey, indicating the possibility that this was the southern extent of the wall and it helps in defining the future search area for the formerly sunken now buried ships. Local residents have found several fragments of ceramics, which attest to the use of the area from an ancient time. The presence of temples and cultural monuments on high ground not only aided our reconstruction, but also spoke to a rich cultural tradition, or a "living history" of the area. The next phase of research will continue to explore and reconstruct the past landscape and perhaps, a remote sensing investigation may identify the lost fleet of Kublai Khan.

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Old Stones Find a New Home

The 2009 Excavation Season at Kızılburun, Turkey

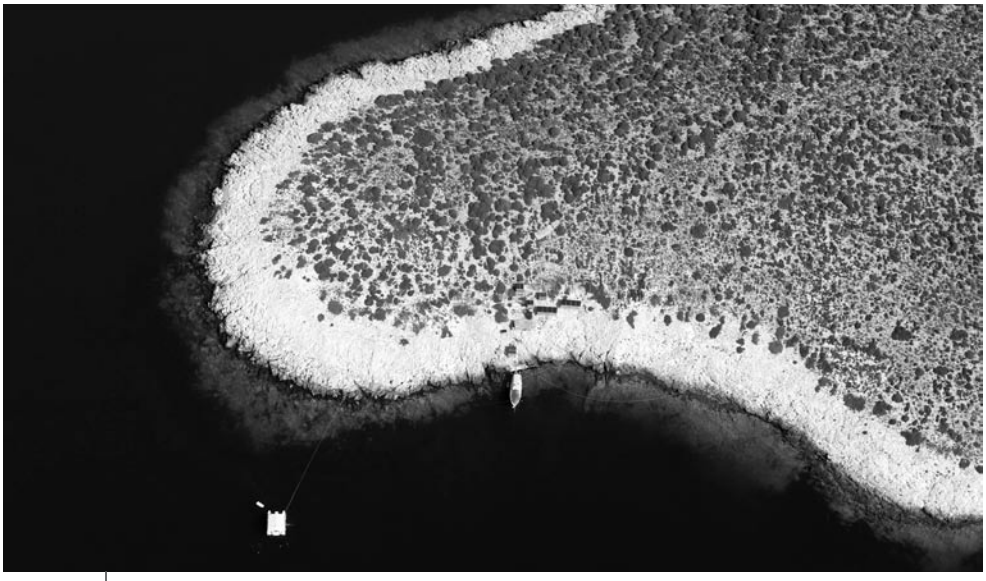


FIG 1
Aerial photo of Kızılburun, or Crimson Cape, showing *Virazon* anchored in front of the 2009 camp and *Millawanda* (with dinghy) moored over the column wreck. Photograph by D. Fulton

For ten weeks between June 5 and August 15, 2009 a team of 20 graduate students, visiting archaeologists, and INA staff completed the excavation of an ancient ship that was transporting more than 50 tons of white marble when it sank off the Aegean coast of Turkey at Kızılburun, probably in the early 1st century BC. The wreck, which lies at a depth of 150 feet, was discovered on the 1993 INA survey directed by Dr. Cemal Pulak; excavation of the wreck commenced in 2005 and resumed in 2009 following a study season hiatus in 2008. Stable isotope analyses of several marble artifacts from the Kızılburun shipwreck indicate that the cargo almost certainly originated on Proconnesus Island in the Sea of Marmara, one of the ancient world's most intensively exploited sources of white marble, quarried since at least the sixth century BC. The central feature of the Kızılburun cargo is a consignment of column parts comprised of eight large drums and a single Doric capital;

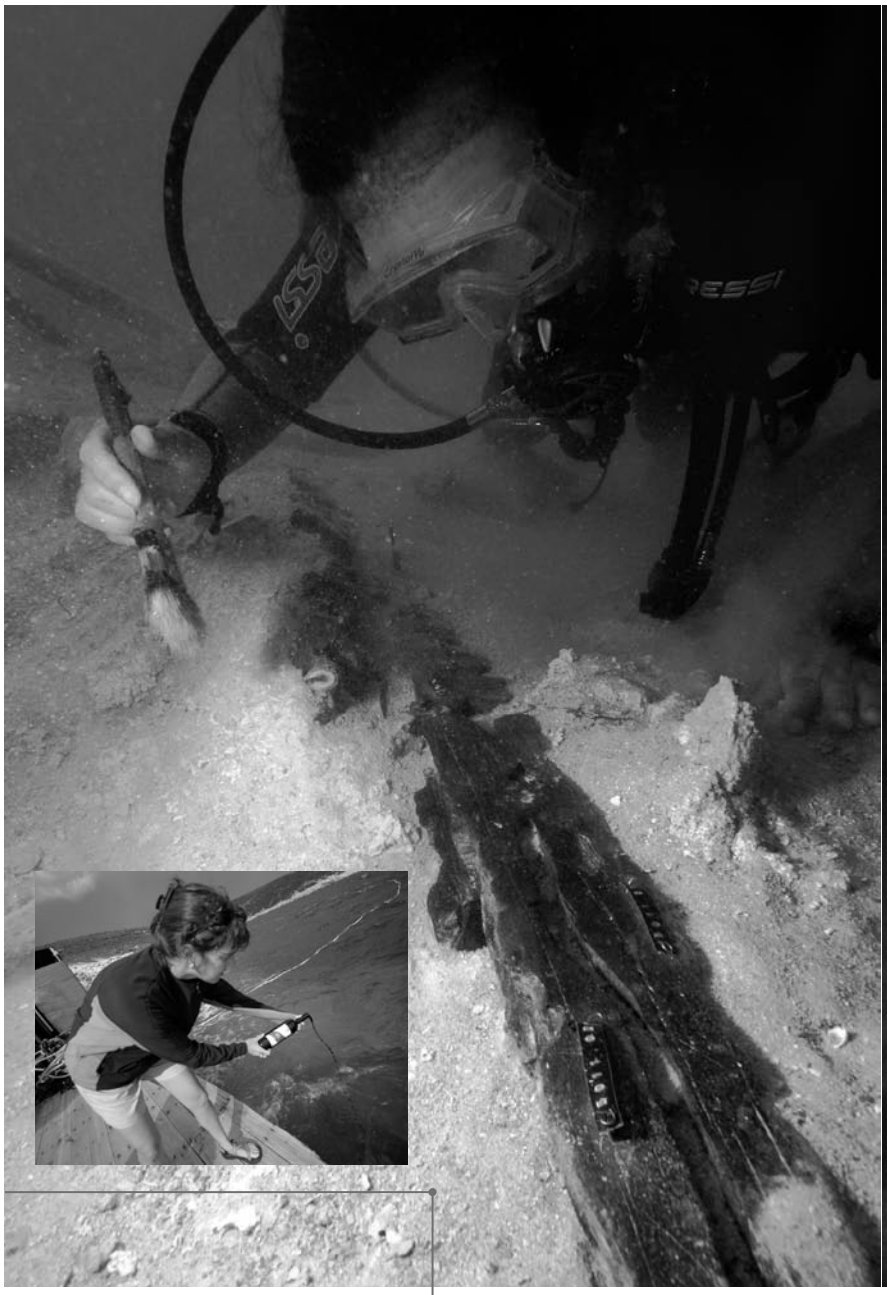
metrological analysis of these parts, together with the location and date of the wreck, suggest that the monumental Doric column was very likely intended for the peristyle at the Temple of Apollo at Claros, but sank short of its final destination.

The 2009 Kızılburun team was composed of participants from Turkey, the United States, the United Kingdom, and Belgium, including six graduate students (three project veterans and three newcomers) from the Nautical Archaeology Program at Texas A&M University. Donny Hamilton served as the Project Director until late June, when he had to return to Texas and Deborah Carlson assumed that post until the end of the field season. The project's 2009 Turkish governmental representatives were friends from previous seasons: Ms. Sinem Özongan (our 2006 commissioner) and Mr. Ilker Tepeköy (our 2005 commissioner). Their familiarity with the wreck site, the camp, the vessels and many of the team members made for an extremely efficient and pleasant summer. Our seaside excavation camp, however, which had suffered extensive damage from wind and storms since it was last used in 2007, had to be largely rebuilt. In late May a group of local carpenters led by INA staff member Mehmet Çiftlikli spent one week on site constructing two dorms, three small cabanas, an artifact storage area, dock and seaside lavatory that served our team of 20 all season. The only building that remained fundamentally intact after five harsh winters at Kızılburun was the galley—our central gathering place for meals, meetings, and movies, and a lasting tribute to Robin Piercy's camp-building expertise.

Approximately half of the initial 15-person excavation team, already busy packing equipment and dive gear at the INA Research Center in Bodrum, arrived at Kızılburun with the *Virazon* and *Millawanda* on June 4. The rest of the team, including the project director, commissioner, and cook, arrived over the next few days. On June 9, with the completion of the first check-out and acclimation dives, the team focused its attention on the three chief archaeological goals of the 2009 season: (1) finalizing the excavation of the site through the mapping and recovery of all artifacts and wooden timbers preserved beneath the column drums, (2) raising to the surface five of the ship's 11 monumental marble architectural elements (two blocks, two column drums, and the column capital), and (3) wrapping the remaining six column drums individually in a protective layer of polyester sheeting until they too can be recovered and cleaned.

FIG 2
Scary moments on board *Virazon* during a lodos storm. Photograph by S. Snowden.

While Deborah traveled to Spain and Italy to present conference papers, INA archaeologist Sheila Matthews organized the on-site installation of datum towers, airlift pipes, safety tanks, and the underwater phone booth. Meanwhile, *Virazon* captain Feyyaz Subay and *Millawanda* captain Bayram Kosar secured the lines that made it possible for *Virazon* to be permanently positioned in front of camp as a floating dorm, hyperbaric hospital, and computer center, and *Millawanda* to be moored daily over the wreck as the platform from which all working excavation dives were launched (Figure 1). Unfortunately, following Deborah's return to camp toward the end of June, four days of stormy weather and rough seas forced the suspension of diving and the repeated evacuation of both *Virazon* and *Millawanda*. On one particularly harrowing occasion, as the sea conditions deteriorated rapidly with the onset of a lodos storm, the propeller of *Virazon*—in the midst of a hasty departure—b ecame fouled on one of the mooring lines (Figure 2). As the snagged ship drifted dangerously close to the rocky shore, INA archaeologist and veteran sailor Orkan Köyağasıoğlu leapt into the sea, dive knife in his teeth, and cut the line, saving



Virazon from an almost certain demise. On shore, the storm dismantled a portion of the dock and most of our seaside lavatory; in desperation, those of us still in camp offered a libation to appease Poseidon (Figure 3).

Airlifting resumed on June 26 and within days divers uncovered one of six thick and roughly-worked rectangular marble slabs previously excavated in 2006 and 2007 and oriented along the ship's longitudinal axis. Team members also re-exposed the best-preserved of the surviving hull timbers, a three-meter long section of a major longitudinal timber (Figure 4). As the excavation continued into July, Kim Rash and Sheila Matthews discovered that the uppermost edge of the longitudinal timber was rabbeted—a clear indication that we were dealing with the remains of the ship's keel.

Excavation of and around the ship's keel continued for the next month and into early August; in the process divers also exposed, mapped, and raised the partial remains of the garboard strake—the hull planking nearest the keel (Figure 5). Other hull remains from the area under the drum pile proved to be insubstantial, composed mostly of small non-diagnostic fragments and isolated, clenched copper nails. While it is disappointing that more extensive

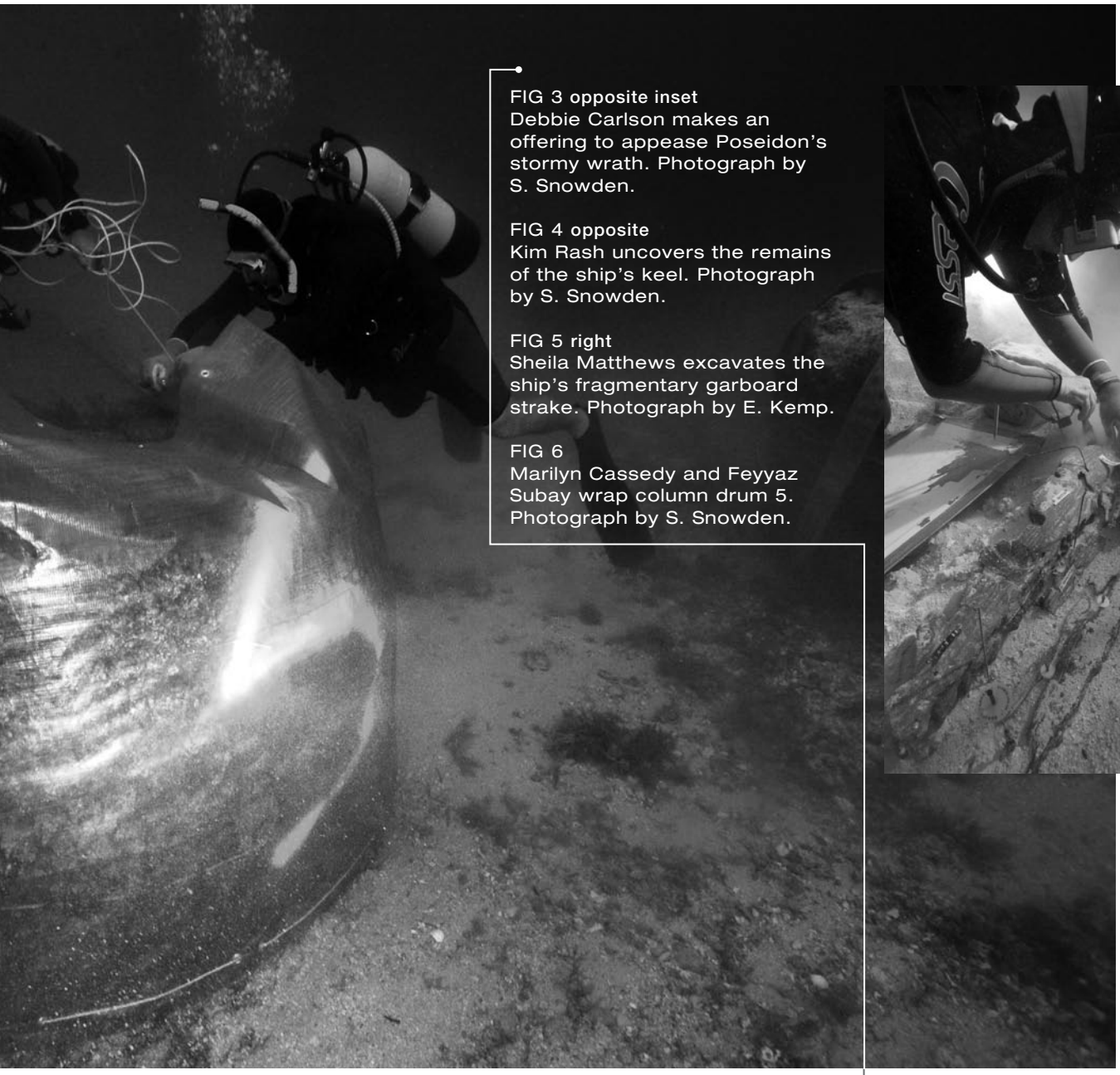


FIG 3 opposite inset
Debbie Carlson makes an offering to appease Poseidon's stormy wrath. Photograph by S. Snowden.

FIG 4 opposite
Kim Rash uncovers the remains of the ship's keel. Photograph by S. Snowden.

FIG 5 right
Sheila Matthews excavates the ship's fragmentary garboard strake. Photograph by E. Kemp.

FIG 6
Marilyn Cassedy and Feyyaz Subay wrap column drum 5. Photograph by S. Snowden.

hull remains were not found in the course of four excavation seasons at Kızılburun (2005–07, 2009), it is worth noting that the recovered timbers represent many of the vessel's key structural components, including ceiling planking, frames, hull planking, and keel. Preliminary dendroarchaeological analyses by botanist Dr. Nili Liphschitz of Tel Aviv University indicate that the Kızılburun hull timbers are of pine, oak and ash; Texas A&M University graduate student John Littlefield is researching the remains of this late Hellenistic ship for his M.A. thesis in the Nautical Archaeology Program.

Those team members working in the area upslope of where the drum pile once was occasionally recovered broken ceramics, nails, and other small finds, but for the most part artifacts subsided once divers encountered a thick, dense and seemingly sterile layer of white chalk atop bedrock. One area that continued to yield small artifacts, however, was around and beneath the large boulder at the shallower, northern end of the wreck site. The size and shape of the boulder restricted access to the area directly underneath, so on July 20 we removed the boulder from the site using the same combination of lifting slings and balloons that had proved so effective for moving the column drums. The amount

FIG 7 above
Detek Salvor lifts column drum 7 from the seabed.
Photograph by S. Snowden.

FIG 8 right
Column drum 4 is offloaded at the Bodrum Museum of Underwater Archaeology.
Photograph by E. Kemp.

FIG 9 opposite
The 2009 Kızılburun excavation team, left to right (rear): Hüseyin Aldemir, Alex Hampton / (center): Sheila Matthews, Debbie Carlson, Bayram Kosar, Eric Kemp, Orkan Köyağasıoğlu, Matthew Partrick, Feyyaz Subay, Nihal Cevik, Ilker Tepeköy, Efe Kurtluoğlu, John Littlefield, Zafer Gül / (front): Mike McGlin, Kim Rash, Courtney Higgins, Laura Gongaware, Fred Roelens, Susannah Snowden, Carrie Atkins Fulton, Drew Fulton. Not pictured: Marilyn Cassedy, Donny Hamilton, Sinem Özongan.
Photograph by M. Cassedy.

of air required to fill the lift balloons attached to the boulder indicated that it weighs nearly 5 tons, which, when coupled with its almost perfectly round shape, seemed to suggest that this may in fact be a heavily concreted (marble?) object from the ship's cargo.

The excavation continued in earnest into early August, with the crating and raising of all surviving wood fragments (most notably the ship's keel) and the exposure of additional areas of bedrock around the site. Meanwhile, several team members were assigned the task of rigging the five marble architectural elements (column capital, drum 4, drum 7, and two large blocks) in preparation for raising them to the surface. This small group of divers was also responsible for individually wrapping the remaining six column drums in thick polyester sheet fitted with grommets which allowed the divers to lace the sheet snugly around the uneven surfaces of each marble drum (Figure 6).

August 10 marked the long-awaited arrival in camp of *Detek Salvor*, an ocean-going tug provided to the project by INA friend Enes Ediz. On August 11, the drum-lifting process began with *Salvor* moored near the wreck site and all eligible team members organized into five dives of two divers each to secure the winch cable and photograph the lift. In less than five hours, the five marble artifacts and curious boulder were winched to the surface and then lifted by crane onto the deck of the *Salvor* (Figure 7). Bodrum Museum representative Emre Savaş and *Virazon* captain Feyyaz Subay oversaw their transport to Çeşme, and then by truck to Bodrum, where they were offloaded into the Museum courtyard (Figure 8).

Over the next few days, our skeleton crew gathered contour data from the seabed, dismantled the camp, and packaged artifacts for transport to Bodrum. On August 19, the Kızılburun artifacts were delivered to Bodrum Museum Director Yaşar Yıldız, who released them to INA's Nixon Griffis Laboratory for conservation. With the excavation of the Kızılburun column wreck

complete, we now turn our attention toward the equally exciting phases of research and conservation; a key part of this process will be determining the extent to which the marble column pieces now in Bodrum can be stabilized and cleaned to better assess their original dimensions.

Acknowledgments

On behalf of the entire 2009 Kızılburun excavation team (Figure 9), I extend our sincere thanks to project director Donny Hamilton, commissioners Sinem Özongan and Ilker Tepeköy, the Turkish Ministry of Culture and Tourism, and the Bodrum Museum of Underwater Archaeology. Our success in raising and safely transporting the massive marble artifacts would not have been possible without the generous help of Enes Ediz of Detek Deniz Teknolojisi and the skilled crew of *Salvor*. While on site our team was looked after by divemaster John Littlefield and cooks Alex Hampton and Zafer Gül. Into our multi-talented family of INA veterans and NAP graduate students, we welcomed photographers Eric Kemp, Susannah Snowden, and Drew Fulton. In addition to documenting the daily events of the project's final season, Eric shot and edited a terrific short film about the moving of the drums, Susannah cheerfully photographed dozens of artifacts at the Bodrum Museum, and Drew created interactive underwater panoramas (accessible at www.wanderersapprentice.com/kizilburun) before bravely agreeing to shoot aerial photos from an ultralight at an altitude of 3500 feet. Visitors to camp during the 2009 season included Dr. Harun Özdaş (Dokuz Eylül University) and Dr. Matthew Partrick (Southern Ocean County Hospital). At the request of INA-BRC director Tuba Ekmekci, the 2009 Kızılburun team was assisted by three hyperbaric interns from Çapa University: Irem Tezer, Abdullah Arslan, and Nihal Cevik. Dr. Zihni Sanus, who participated in the INA's Bozburun shipwreck excavation, served as our physician for the final two weeks of the campaign and accompanied the team safely back to Bodrum. Finally, and most importantly the 2009 excavation season at Kızılburun could not have occurred without the financial support of the directors and friends of the Institute of Nautical Archaeology, Texas A&M University, the Center for Maritime Archaeology and Conservation, the Samuel H. Kress Foundation, and the International Catacomb Society.

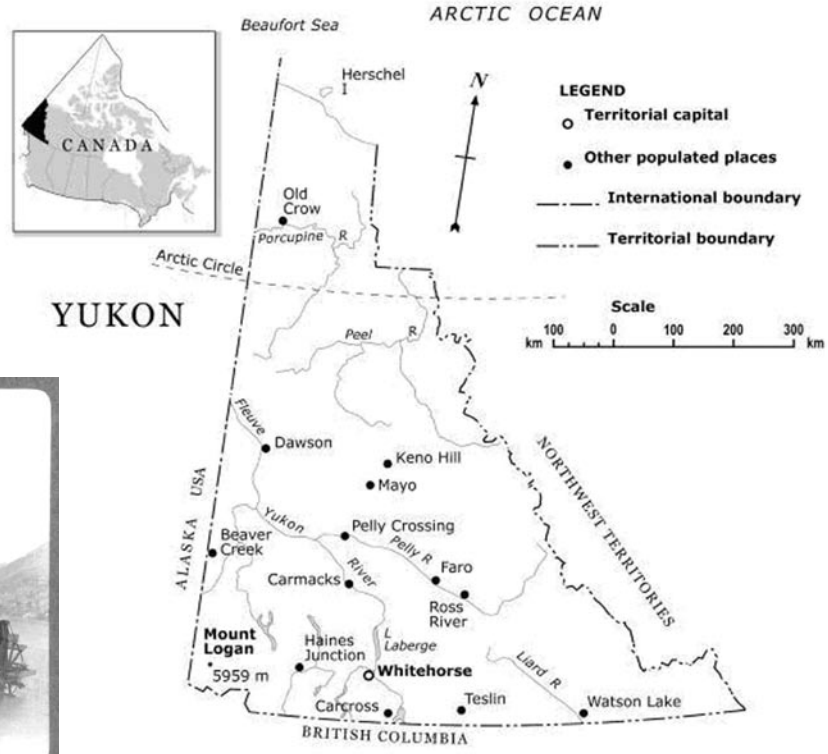
John Pollack INA
Doug Davidge Yukon Transportation Museum
Robyn Woodward INA

Yukon River Survey 2009

During 2009 the Yukon River Survey continued its multi-year mission to document the numerous and well-preserved historic steamboats of the Yukon Gold Rush (Figure 1). Our field seasons involve two separate phases or projects run back-to-back. This year we made the first dives on an undisturbed wreck—

FIG 1 right
General location map for the Yukon Territory
Drawing by J. Pollack.

FIG 2 below
Historic image of *A.J. Goddard* on Lake Bennett. Courtesy Alaska State Library.



A.J. Goddard—in Lake Laberge. We also conducted a hull documentation project on a large and uniquely constructed stern wheel steamboat, *Seattle No. 3* , at West Dawson.

Phase One—*A.J. Goddard*

While archival material is sparse, it appears the components of the small *A.J. Goddard* were prefabricated in two locations in 1897—a hull in San Francisco, and the engines and boiler in Seattle—before being shipped north to either Skagway or Dyea, Alaska. The disassembled ship was packed overland by men, horses, and possibly tramlines across one of two mountain passes , into the headwaters of the Yukon River. It and (possibly) a sister ship, were assembled over the winter on the shores of Lake Bennett, and launched in the spring of 1898. The tiny stern wheel steamboat measured only 15.2 x 3.2 x 0.9 m, with a gross displacement of 86.7 tonnes. Captain Goddard and his wife, Clara, made the one-way run through the rapids to Whitehorse, and the ship was the first vessel to arrive at Dawson City from upstream in 1898. Ownership changed in October 1899 when the ship was sold to Henry Munn of the Canadian Development Company. The small vessel met its demise in a storm while towing a scow at the north end of Lake Laberge in October 1901. Three of five crew were drowned when the vessel foundered (Figure 2).

Doug Davidge, INA member and president of the Yukon Transportation Museum, had searched for this famous Klondike vessel for 22 years. A promising earlier target was pinpointed during the 2008 INA field trip to the Thirty Mile section of the river, and its identity was confirmed by Doug that summer using a drop camera and an ROV.

The 2009 team included John Pollack (Project Director), Doug Davidge (Yukon Transportation Museum), Jim Delgado (CEO, INA), Donnie Reid (Canadian Space Agency) and Lindsey Thomas (TAMU-NAP graduate student). For the second year, the Yukon Government participated by supplying both Tim Dowd (Operations Manager, Heritage Sites Branch) and a 21-foot riverboat. We also utilized outfitter Rob Hewer's riverboat to transport a large amount of camp gear and forty dive tanks, and set up a wilderness camp some thirty kilometers from the road.

The team dove on the wreck in 37^0 F water in early June, one day after the ice had broken up on the northern end of the lake. *A.J. Goddard* lay upright and canted slightly to starboard in 9–11 m of water several hundred meters offshore. Reports of the loss mentioned the ship was towing a scow or barge at the time of the accident. It is not clear whether the barge sank, and our searches failed to locate the barge in the immediate vicinity of the shipwreck .

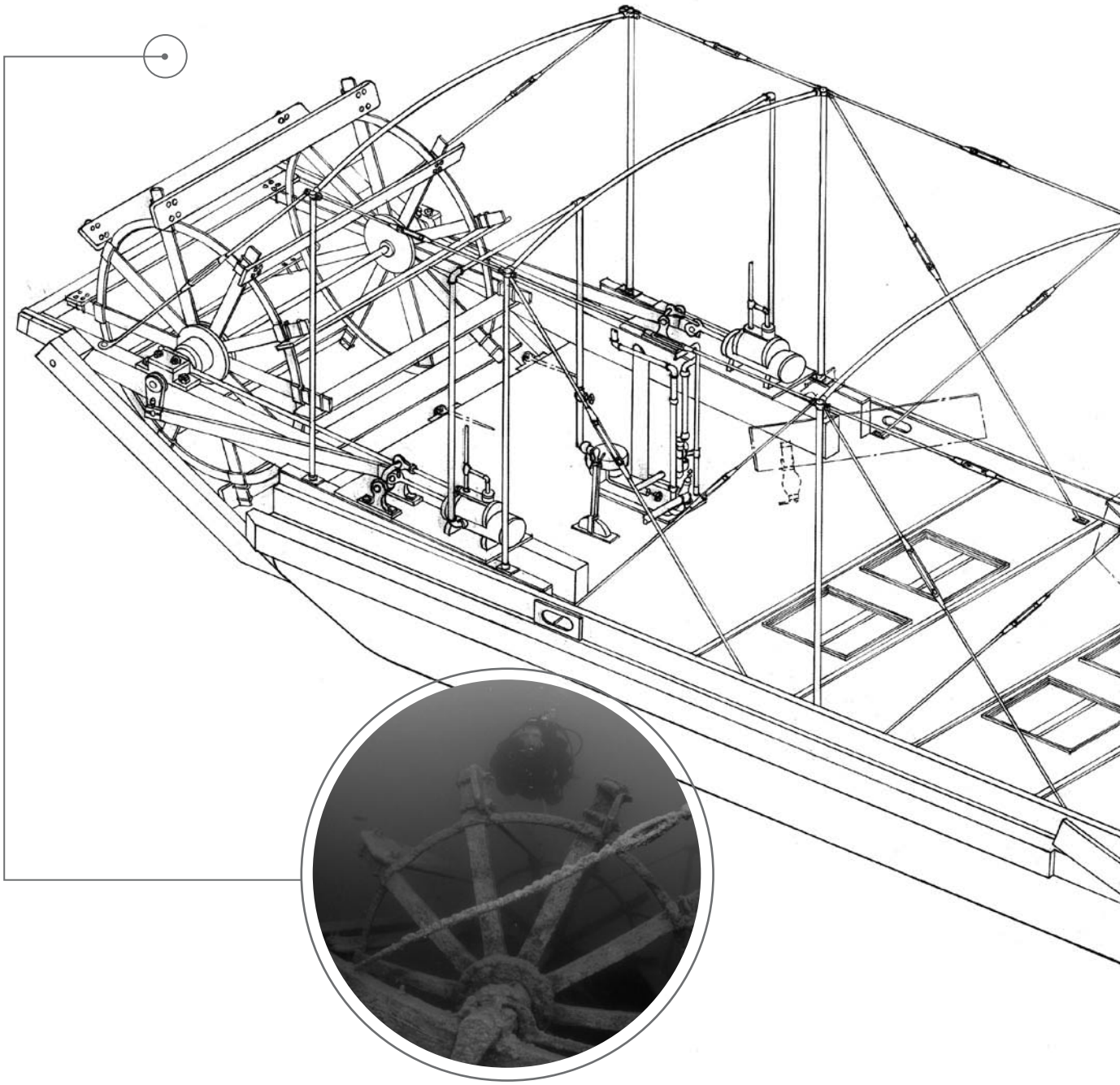
The vessel was remarkably intact. All components of *A.J. Goddard* were present with the exception of the small pilothouse, stack and ship's wheel (Figure 3). Very little damage was visible. The vessel was built with a riveted steel hull displaying a spoon bow, five pairs of tubular steel hog posts, and diagonal hog chains in an "X" pattern. Each set of hog posts was joined at the top with a cross-member running athwartships. The vessel has no "sides" or wooden superstructure—it was open except for canvas curtains that provided passengers with modest protection from the elements. We believe a lightly-constructed wooden upper deck was supported by the hog posts.

The main deck displayed ten hatches arranged in five sets of two. Two sets of hatches were located forward of the boiler, and a store of firewood was still visible below the main deck. The remaining three sets of hatches aft of the boiler did not contain cargo or firewood except for a single empty crate. There may be another set of large hatches immediately forward of the transom, but the collapse of the splash guard for the paddle wheel has obscured this area with debris. None of the ten accessible hatches had covers, suggesting they were not secured. We suspect the hatches were washed away as the vessel foundered, and this oversight may have contributed to the demise of the ship in 1901. Two axes lay on the deck near the bow of the ship and suggest the crew struggled to cut away the barge as the ship began to founder.

Within the hull we observed longitudinal cross-members (e.g. girders) below the main deck and outboard of the hatches on both sides of the vessel. It was not possible to determine if the hull was constructed with transverse, water-tight bulkheads, but given the number of hatches observed on *A.J. Goddard*, this design is likely.

A small boiler, two horizontal high-pressure engines, pitmans, eccentrics and paddlewheel were intact and complete. An engineer's station with control lever was located aft of a small, horizontal water tube boiler. The vessel had a small, simple paddle wheel and three steel rudders and the tillers entered the hull below the level of the main deck. We noted the steam intake and exhaust pipes connecting the cylinders, run athwartships at the top of the hog posts. This arrangement is a unique configuration not seen on larger vessels on which these pipes are located below the main deck. Neither feed nor bilge pumps were seen on deck, although there was a hose on the starboard side of the boiler, and running overside. The port side door of the boiler was open, and the firebox is filled with unburned wood suggesting the crew may have tried to restart the fire as the vessel was sinking.

There is no evidence *A.J. Goddard* carried a cargo or mercantile goods



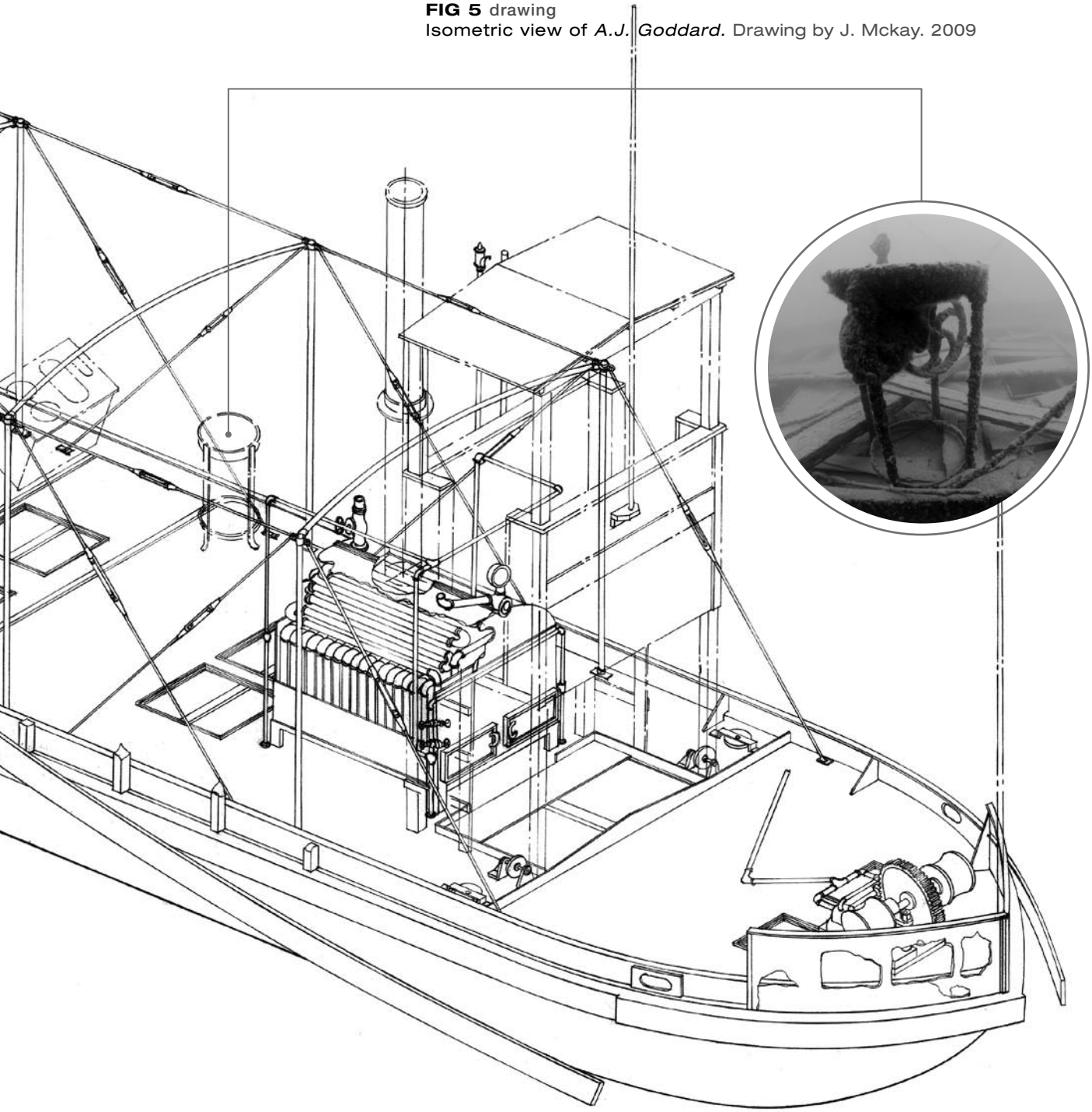
A.J. GODDARD - 1898

Interpretive Reconstruction Drawings
John W. Mckay September, 2009
From the Baseline Survey by
John Pollack and Lindsey Thomas, June, 2009

FIG 3 bottom left inset
Lindsey Thomas and the intact stern wheel of *A.J. Goddard.*
Photograph by D. Reid.

FIG 4 right inset
A small blacksmith's forge is bolted to the deck of *A.J. Goddard*
Photograph by D. Reid.

FIG 5 drawing
Isometric view of *A.J. Goddard.* Drawing by J. Mckay. 2009



when it sank, although the fate and contents of the barge are unknown. Nonetheless the ship contained a modest collection of material culture in terms of tools, cooking utensils, and personal goods. These artifacts lie within 25 m of the ship suggesting she sank very quickly. They represent the contents of a small, working stern wheel steamboat in which the crew had to be self-sufficient, and capable of caring for themselves on a wilderness river. Woodworking and blacksmithing tools were carried to repair breakdowns. A small forge and anvil are on board along with a small workbench with machine vice (Figure 4). A pair of blacksmith tongs lies to 7 m +/- to starboard, and an assemblage of auger bits, saws, wrenches and other tools has spilled down the rail on the port side of the ship, and now lies on the lake bottom. In addition to the two axes found on the foredeck, there is a shovel and axe on the bottom immediately to port of the boiler, and a fourth (double-bitted) axe 8 m +/- from the wreck on the starboard side of the vessel. Bottles, pots, dishes and assorted cooking gear lay scattered around the wreck, with the main concentration of enamelled-ware on the starboard side, roughly 10 m to starboard of the paddle wheel. Eight to ten bottles typical of the period were noted including an ink bottle. A small pitcher was found on the lake bottom below the rail on the port side. Likewise, the long bones of a large mammal were found adjacent to the ship, suggesting fresh meat was on board.

Ship's artifacts include steam gauges, a small navigation light lying on the aft port rail, and the steam whistle and safety valve are attached to piping now lying on the lake bottom. Remnants of the canvas side curtains are scattered around the ship along with planking from the upper deck. Artifacts associated with the crew include two boots, presumably kicked off when the crew members went into the water, and what may be the remains of a coat.

Our work in June 2009 consisted of a photo inventory of the vessel and its artifacts. A baseline survey of the vessel was conducted by Pollack and Thomas and later drawn by John MacKay (Figure 5). No artifacts were raised, measured in detail, or removed from the site—this work will be conducted in 2010. Likewise, administrative actions are being taken by the Yukon Government, to protect the wreck via Historic Site Designation and registration with the Receiver of Wreck. Co-incidentially, a total station survey of the wreck of the 36.3 m, 1898 wooden-hulled stern wheel steamboat *Vidette* was undertaken to document the ice-driven, wreck formation process functioning in very shallow water on Lake Laberge.

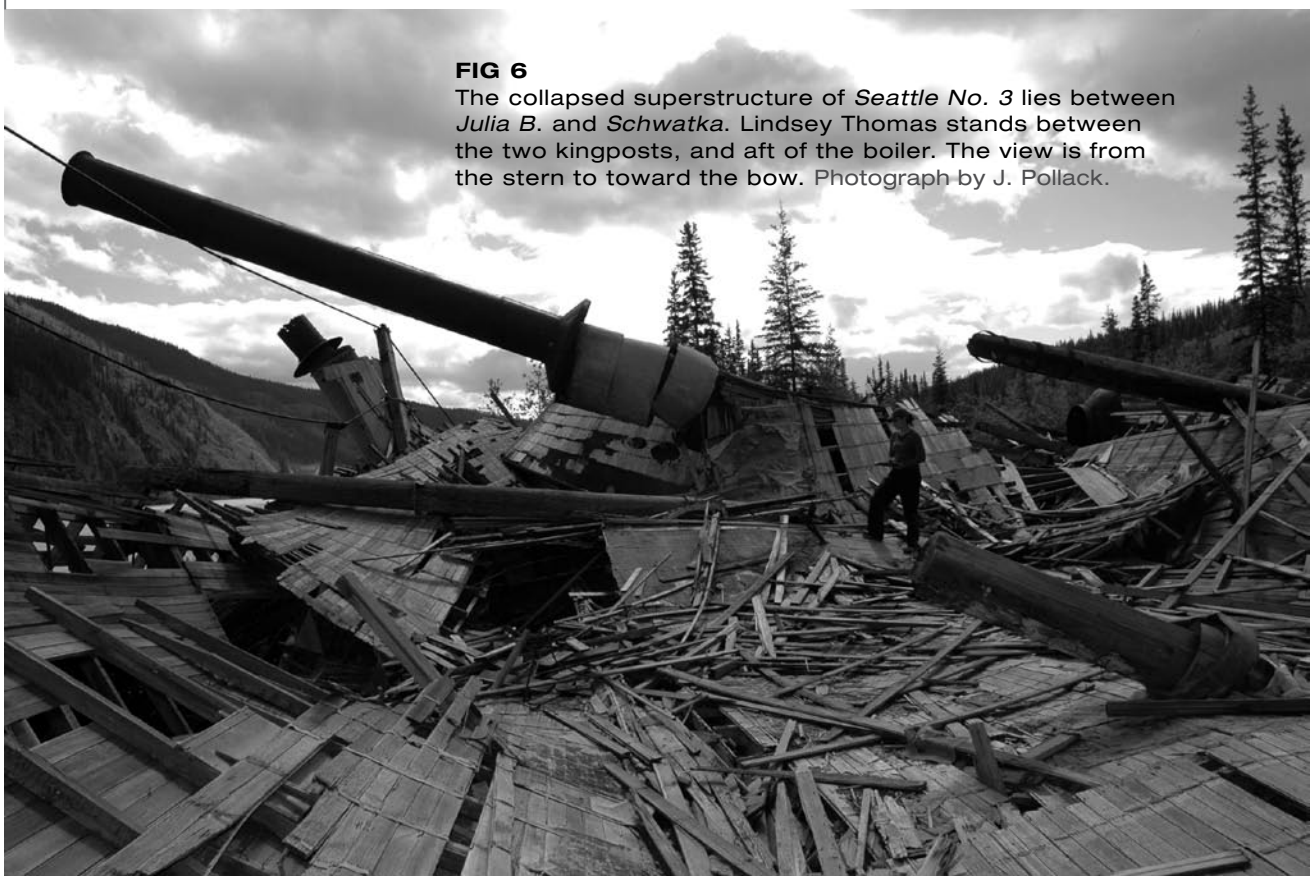


FIG 6
The collapsed superstructure of *Seattle No. 3* lies between *Julia B.* and *Schwatka*. Lindsey Thomas stands between the two kingposts, and aft of the boiler. The view is from the stern to toward the bow. Photograph by J. Pollack.

FIG 7 below
Dr. Woodward excavates the collapsed foredeck of *Seattle No. 3* Photograph by J. Pollack.

FIG 8 bottom
Provisional plan view of *Seattle No. 3.* Drawing by J. MacKay.

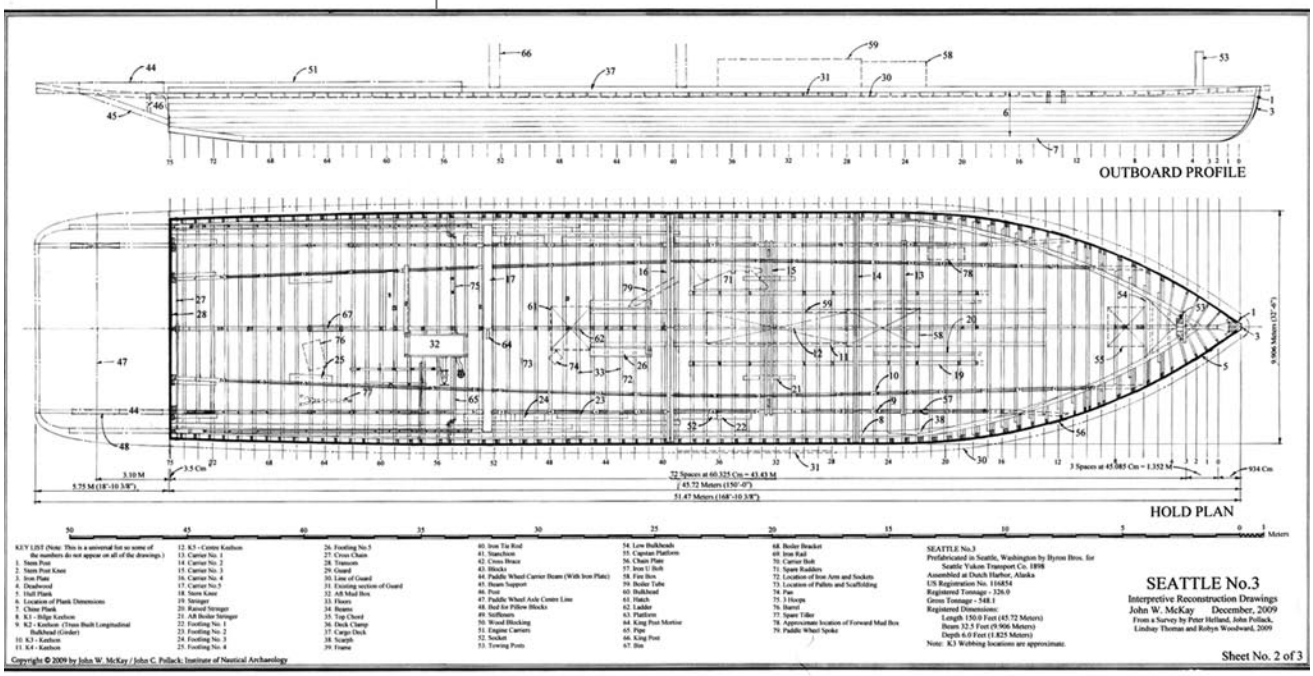
Phase Two—Seattle No. 3

Two days after Phase One was concluded, a four-person team consisting of Peter Helland, John Pollack, Lindsey Thomas and Dr. Robyn Woodward drove 530 km north of Whitehorse to Dawson City. This second phase involved work on an above-water hulk at the West Dawson "boneyard", where a detailed hull plan was prepared of the wooden-hulled *Seattle No. 3.*

Seattle No. 3 was a prefabricated vessel, originally framed in Seattle at the Moran Brothers yard, and assembled at Dutch Harbour in the Aleutian Islands in 1898. The ship measured 45.7 x 9.9 x1.8 m with a gross displacement of 548.1 tonnes. The ship was built for the Seattle-Yukon Transportation Company and initially worked on the run between the mouth of the Yukon River and Dawson City. The vessel's later history is unclear. Currently the vessel lies above water and derelict. Its superstructure has collapsed with only the aft crews quarters and steering compartment intact (Figure 6). Decking, deck beams and the wooden hull are intact and complete except at the bow. A single locomotice-style boiler and single stack with breeching located aft, are *in situ*. The stern wheel and engines are missing. This vessel contains a unique but incomplete four-tiller and roller-steering system with the tiller arms riding slightly above the freight deck. Iron-sheathed wooden semi-circles for tiller bearings are affixed to the freight deck, but the tillers, rudders and rudder posts are missing. The centerline king posts remain, but the outlying hog posts are removed.

Despite the mass of collapsed superstructure on the main deck, most of the hull was intact except for the forward 12 frames. Robyn Woodward tenaciously excavated this area to expose most of the frames and some of the floors around the capstan and forward (Figure 7). The remainder of the hull's interior was intact and accessible with helmets and headlamps.

Our primary goal was to produce a plan view with longitudinal and transverse elevations. A standard baseline survey was utilized combined with a Nikon reflectorless total station to map the partially collapsed bow and the transverse cross-sectional elevations, later drawn by John MacKay (Figure 8).



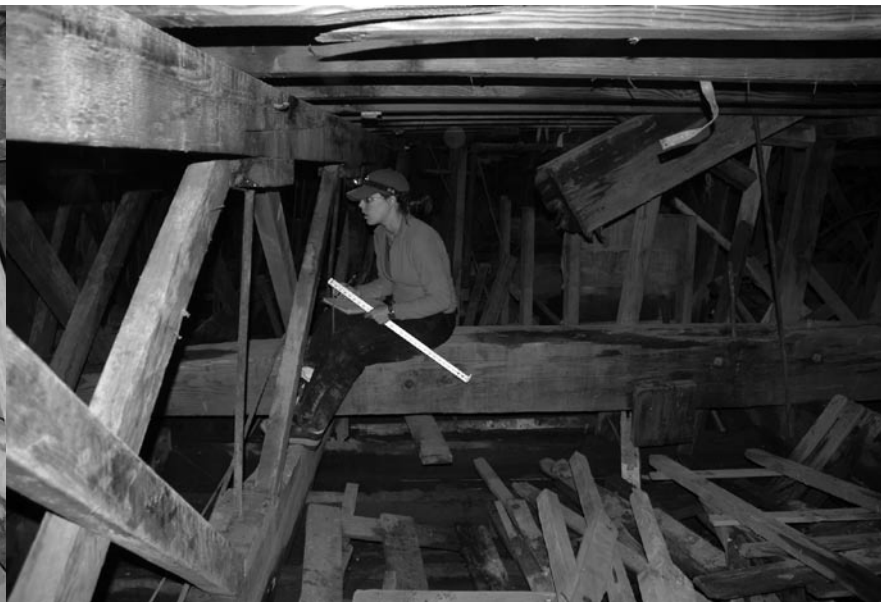


FIG 9 above left
The truss-built, longitudinal bulkheads within the hull of *Seattle No. 3.* Photograph by J. Pollack.

FIG 10 above right
A transverse carrier and toppled kingpost in the hold of *Seattle No. 3*. Photograph by J. Pollack.

These efforts yielded some interesting findings. *Seattle No. 3* is the most heavily built stern wheel steamboat yet examined in the Yukon, with a total of nine major longitudinal strength members contained within her hull. The main longitudinal structures consisted of a centerline keelson with hold stanchions, and four side keelsons supporting truss-built, longitudinal bulkheads or girders running from the transom, forward (Figure 9). The two inboard girders on either side of the centerline keelson, were distinctively curved—a feature not seen by the authors on other Canadian stern wheel steamboats. An additional pair of short girders supported the outboard portions of the engine beds. Finally this vessel displayed a heavy bilge keelson, as compared to the more typical cocked hat chines. Frames and floors were commonly single, but often doubled or even tripled in no clear pattern.

As well as these extra and oversized longitudinal strength members, the vessel also contained 5 large transverse beams or carriers supporting the boiler and two king posts (Figure 10). We have noted similar transverse beams resting atop the side and centerline keelsons and supporting kingposts in *Schwatka*, but it is an uncommon design. In addition to the centerline kingposts, there were two rows of hog posts not supported by transverse beams, but rather by footlings, or short timbers running longitudinally on top of the floors.

The heavy construction of *Seattle No. 3* made it possible for the vessel to work in the shallow water upstream of Dawson City. This ship is far more robust than *Evelyn*, a vessel of somewhat smaller size that contains only two (vs. *Seattle No. 3*'s four) truss-built longitudinal bulkheads on either side of a centre-line bulkhead. *Seattle No. 3* is more heavily constructed than the twelve "assembly line" stern wheelers built by the Moran Bros. in Seattle and then moved north to St. Michael under their own power. These latter vessels lacked the additional truss-built longitudinal bulkheads, and the chines of these ships and many other vessels utilized the lighter cocked-hat design. We have no conclusive explanation for the heavy construction approach used on *Seattle No. 3*.

A second finding concerns the use of the hold to haul freight. A large hatch was located between frames 45 and 48, and numerous pallets were found in the hold adjacent to the hatch. It is possible that the additional longitudinal bulkheads outboard of the centerline make up for the reduction in size of the

centerline longitudinal bulkhead and utilize a sparse number of hold stanchions above the center keelson. This open design in the main hold aft of the boiler, when combined with the hatch and a 1.83 m hull depth, suggests *Seattle No. 3* carried freight below decks, sited on top of pallets that lay on the frames. If this is correct, then it is the first such vessel noted in Western Canada.

Our third finding was the discovery of a substantial and unexpected collection of spare parts in the hold, including two spare rudders, a rudder post, a paddle wheel spoke, numerous iron circles, the remains of large diameter (freshwater storage) casks, and other unidentified hardware and fittings. The general locations of these artifacts are noted on the plan view. Clearly material culture exists in the holds of the vessels at West Dawson, and further examination is warranted .

Summary

The 2009 field season has yielded the first undisturbed, Gold Rush era steamboat with a modest but important collection of material culture. Additionally, continued work on one of the seven vessels lying at West Dawson, has found it to be the first documented case of a western stern wheel steamboat designed to haul freight in her hold, as compared to the usual practice of hauling freight on the main deck. A substantial collection of ship's spares were located and documented. Detailed surveys of both vessels were produced, including plan, elevation and isometric views by John McKay. *Seattle No. 3* is the third vessel on which we have collected detailed hull measurements, the first being the 39.6 m, 1908 wooden-hulled *Evelyn*, and the second being the 1898 composite-hulled stern wheel steamboat *Moyie* at Kaslo B.C, where work was initiated in 2008.

Acknowledgements

The authors wish to acknowledge the National Geographic Society / Waitt and the RPM Foundations, for their support of Phase One, and Promare, INA and the RPM Foundation for their support of Phase Two. Additional financial and logistical support came from the Yukon Historic Resources Fund, the Heritage Branch of the Yukon Government, the Yukon Transportation Museum, TAMU Nautical Archaeology Program, and the Vancouver Maritime Museum. Jim Delgado, Gregg Cook, Jeff Hunston, Tim Dowd, Kevin Crisman, Doug Olynuk and numerous INA members have been strong supporters and we thank all of you. Finally, we thank the Ta'an Kwach'an Council and elders for their hospitality.

Suggested Reading

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Pollack, J., D. Davidge, and R. Woodward. 2009. "A Summary Report for the 2008 Yukon River Survey Project: Report No. INA-124-2008/2." Report to Heritage Resources Unit, Yukon Government, Whitehorse, from the Institute of Nautical Archaeology, College Station, TX.

Pollack, J.C., R.P. Woodward, N.A. Easton, and C.G. Velazquez. 2009. "Ships of the Yukon Gold Rush." *ACUA Underwater Archaeology Proceedings.* Society for Historical Archaeology. 287–297.

Outreach

SHA Yukon Symposium
A Yukon symposium of five papers was given on January 7, 2010 at Amelia Island, Florida, during the 2010 meeting of the Society for historical Archaeology.

National Geographic Society Website:
http://news.nationalgeographic.com/news/2009/11/photogalleries/091124-ghost-ship-yukon-shipwreck-pictures/index.html

INA Website:
http://inadiscover.com/projects/all/north_america/yukon_gold_rush_steamboat_survey_canada/introduction/

PROMARE Website:
http://www.promare.org/project_yukon.html

Justin Leidwanger
University of Pennsylvania / INA
Nicole Cassano
University at Albany, New York State Museum

Eastern Cyprus Maritime Survey
—A Preliminary Report on the 2009 Field Season

Summer 2009 marked the continuation of the Institute of Nautical Archaeology's annual field surveys off the coast of Cyprus. Over the course of seven campaigns since 2003, archaeologists from INA have worked with specialists and students from other institutions to explore a variety of sites in the shallow waters off the south and southeast shores of the island, including several shipwrecks, anchorages, and other sites of maritime cultural activity. In 2009, the team continued its focus on promising areas at Cape Greco and Protaras, where it has undertaken the Eastern Cyprus Maritime Survey annually since 2006 (Figure 1). This prominent area around and just north of the cape would have been a crucial landmark not only for coastal sailors, but for mariners heading east or making landfall after crossing from the Levant.

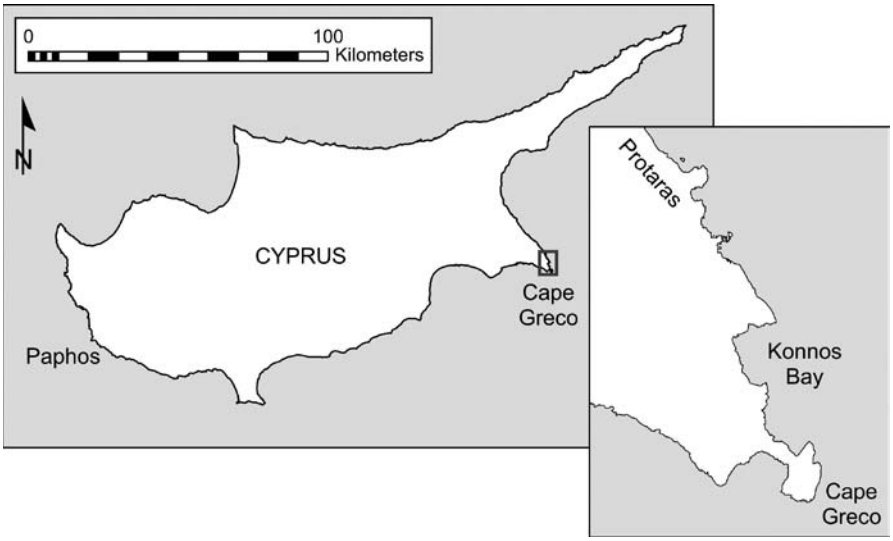

FIG 1
Maps of Cyprus and the Cape Greco survey area showing places of interest mentioned in the text.
Maps by J. Leidwanger.

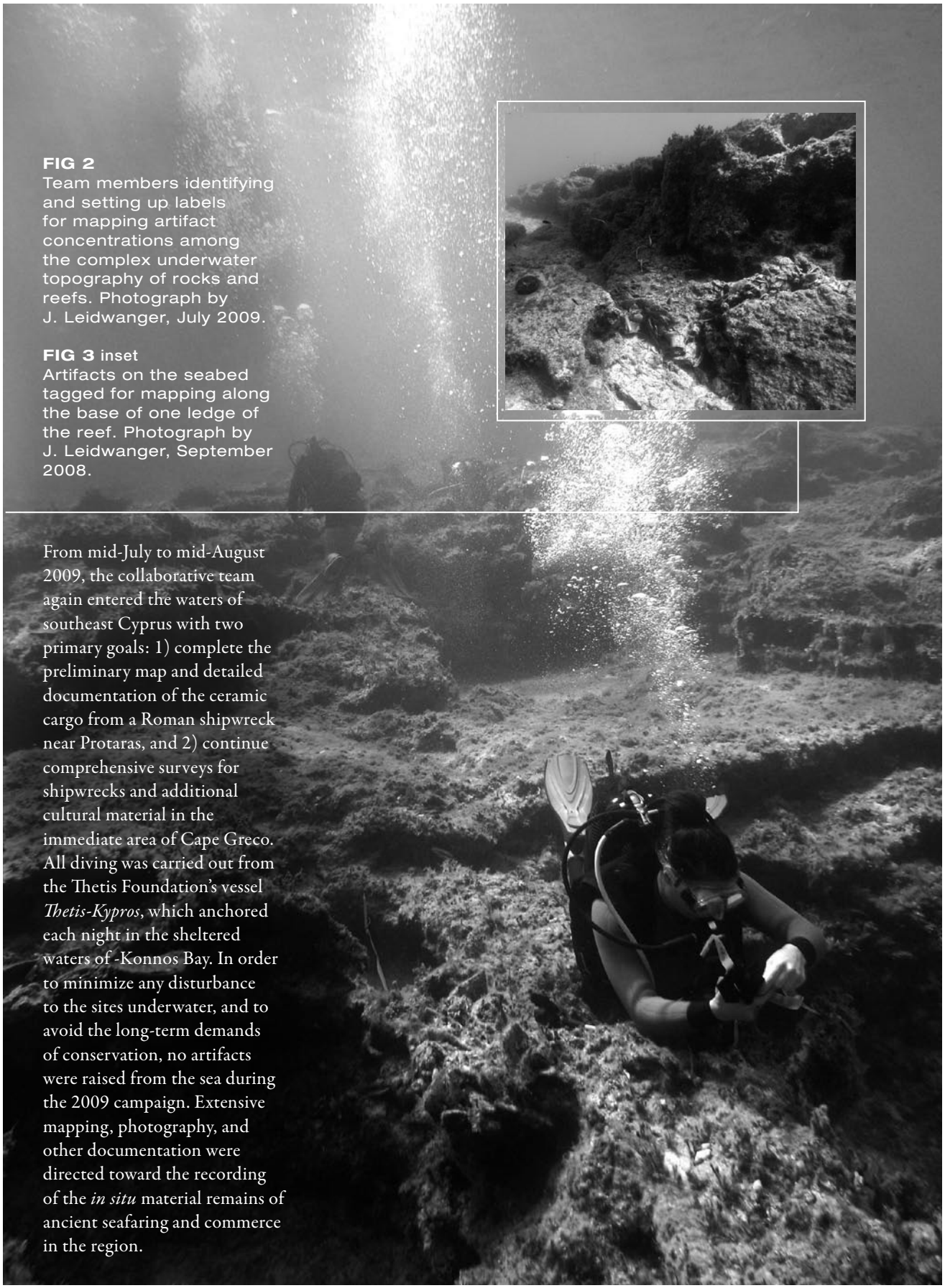

FIG 2
Team members identifying and setting up labels for mapping artifact concentrations among the complex underwater topography of rocks and reefs. Photograph by J. Leidwanger, July 2009.

FIG 3 inset
Artifacts on the seabed tagged for mapping along the base of one ledge of the reef. Photograph by J. Leidwanger, September 2008.

From mid-July to mid-August 2009, the collaborative team again entered the waters of southeast Cyprus with two primary goals: 1) complete the preliminary map and detailed documentation of the ceramic cargo from a Roman shipwreck near Protaras, and 2) continue comprehensive surveys for shipwrecks and additional cultural material in the immediate area of Cape Greco. All diving was carried out from the Thetis Foundation's vessel *Thetis-Kypros*, which anchored each night in the sheltered waters of -Konnos Bay. In order to minimize any disturbance to the sites underwater, and to avoid the long-term demands of conservation, no artifacts were raised from the sea during the 2009 campaign. Extensive mapping, photography, and other documentation were directed toward the recording of the *in situ* material remains of ancient seafaring and commerce in the region.

Ongoing Investigations of a Roman Shipwreck

The majority of the 2009 field season was dedicated to continued investigations at the site of a Roman shipwreck discovered two years earlier north of the cape toward the beach resort of Protaras. The vessel wrecked in shallow waters not far from shore; its cargo is largely broken and widely scattered over an area of roughly 70 by 45 meters. These new investigations built on the results of the 2008 season, when almost half of the area was mapped and the primary cargo components were identified. Following the cultural material out to sea, the team extended its documentation to elements of the ship's cargo situated among the complex underwater topography of rocks and reefs (Figures 2 and 3). The extensively dispersed site is likely the result not only of wrecking in such a shallow environment and so close to shore, but also of dynamic post-depositional processes associated with particularly strong waves and currents.

The work aimed to complete a non-intrusive preliminary map of surface remains, a photomosaic, full counts of diagnostic artifacts (rims, bases and handles), and the identification of non-cargo ceramics. Having divided the site into 38 artifact concentrations that were more manageable in this difficult topography, the team was able to use Site Recorder 4 to map the individual areas. The digital reassembly of these plans and photos is underway.

While most of the visible assemblage consists of amphora sherds of several regional and international types, additional associated artifacts were also documented. A number of roof tiles found scattered on the north side of the site may suggest a ship's cabin or galley. Near the northeast edge of the site, several fragmentary common wares—including the rim of a large shallow bowl and handles of several common and cooking ware vessels—hint at daily life on board for Roman seafaring merchants, but are unfortunately too poorly preserved to provide a date or more precise identification under water. Investigations of these surface remains have yet to reveal evidence for the ship's anchor, other fittings, or wood from the vessel itself; in light of the seabed conditions and dispersed remains of the cargo, such finds seem unlikely.

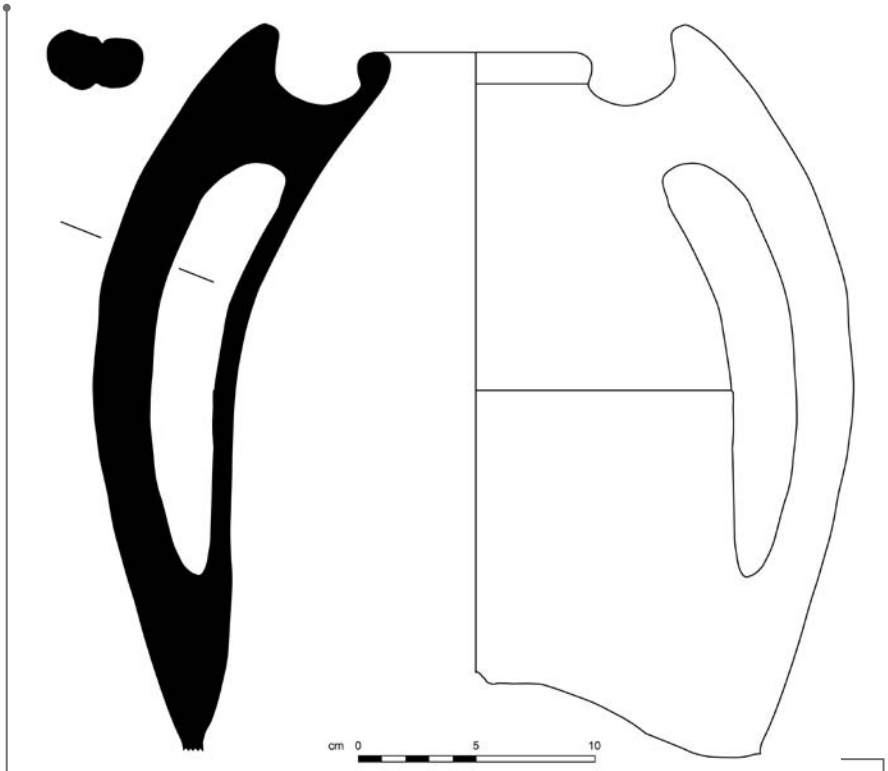

FIG 4
An example of an Agora M54 amphora top (ECMS-08-002) raised in 2008 for more extensive documentation. Drawing by N. Cassano and J. Leidwanger.

The remaining artifacts visible on the surface are broken cargo amphoras, totaling at least 133 individual jars in three major types. Due to the shallow-ness and accessibility of the site, it seems likely that additional or better-preserved cargo and other wares would have been removed either in antiquity or more recently. Aside from a few Hellenistic amphora sherds toward the east edge of the site, intrusive ceramics are exceptionally rare.

Representing nearly two thirds of the total amphora assemblage, the most common type recorded is the Agora M54 jar. Also known as 'Pseudo-Cos en cloche', this form is characterized by its convex 'bell-shaped' upper body, a marked carination at the midsection, and a convex lower body terminating in a peg toe. It lacks a neck, but rather has a simple outturned rounded rim and bifid handles that curve upward before angling down sharply and following the shoulder profile (Figure 4). These distinctive handles clearly follow in the same widespread early Roman tradition that includes Dressel 2/4 jars in the west, adapted loosely from amphoras produced throughout the Hellenistic period and earlier on Kos and the nearby mainland. The type is thought to have been manufactured across from Cyprus in neighboring Cilicia, where evidence of their production during the 1st and 2nd centuries AD has been brought to light at several likely workshops around the Bay of Iskenderun.

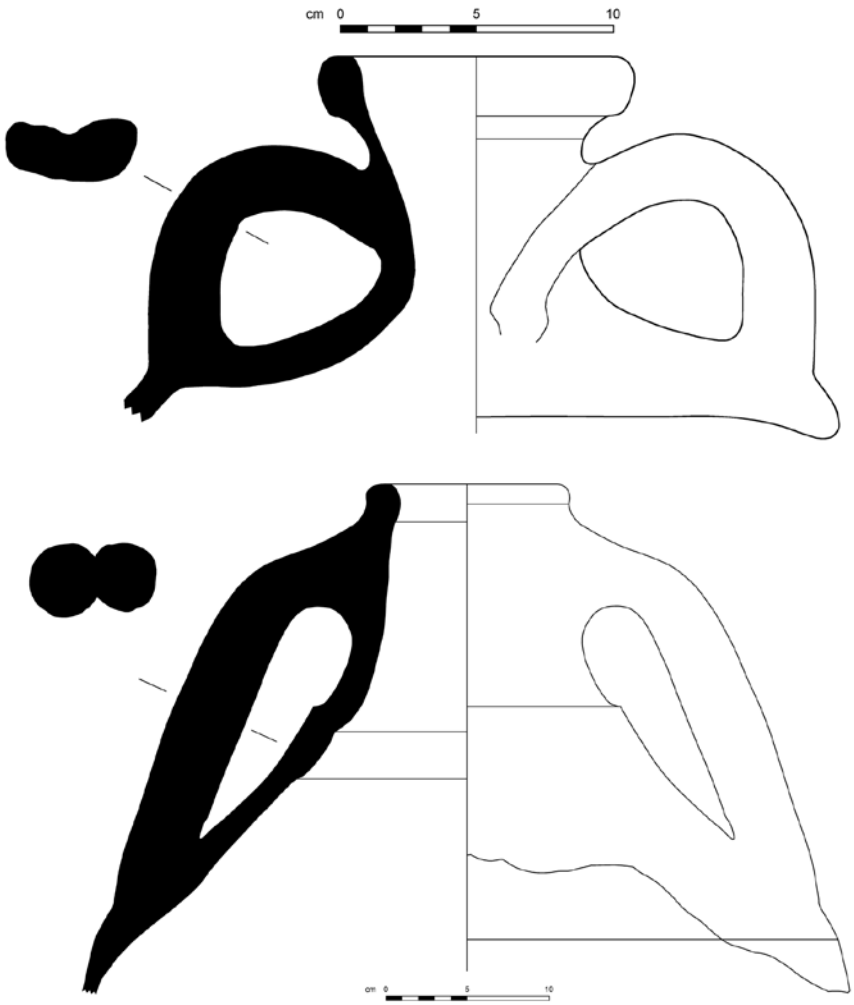

FIG 5 above top
An example of a Gauloise 4 amphora top (ECMS-08-006) raised in 2008 for more extensive documentation. Drawing by N. Cassano and J. Leidwanger.

FIG 6 above bottom
An example of the top of the third amphora type (ECMS-08-003) raised in 2008 for more extensive documentation. Drawing by N. Cassano and J. Leidwanger.

Accounting for just over one quarter of the total amphora assemblage, the second type recorded on the seabed consists of formally similar jars in two distinct fabrics. They exhibit a slightly conical neck with a prominent thickened rim. Flat grooved handles rise from the middle of the neck before curving down to meet the broad shoulders (Figure 5). No examples survive intact, but diagnostic shoulders and bases show that the body is generally ovoid, terminating in a simple flat resting surface or a separately made ring. The type shows some internal morphological diversity, and selective raising of artifacts during the previous season in 2008 revealed that the group is comprised of jars with at least two very different fabrics indicating distinct geographical origins. One subgroup corresponds to the fabric and form of Gauloise 4 amphoras from the Mediterranean coast of France, a type widely distributed around the Roman world but only rarely in very large numbers in this corner of the Mediterranean. The second fabric corresponds to a form that presents a slightly less conical neck, rounded rim, and more complex handle section with external grooves. Importantly, the fabric reflects a drastically different clay resource that is generally reminiscent of later LR1 amphoras typically associated with Cilicia; it would seem to represent a regional imitation of the internationally circulating Gauloise 4 jars. The relative proportion of imitations within the assemblage is unclear at present, but limited seabed counts—necessarily tentative because of the difficulty of clearly identifying fabrics in an underwater environment—suggest that the genuine Gauloise 4 amphoras are the majority. Several of the bases raised for further study or observed on the seabed contained traces of pitch lining, which may indicate a wine content for this type.

With only a handful of examples, the third and smallest type is a rather problematic form with few good comparanda. This amphora, too, survives only in fragments, but must have been characterized by a wide cylindrical neck with a simple vertical rounded rim and massive bifid handles following the angular profile of the carinated shoulders. The maximum diameter would have been well below the midsection, resulting in a somewhat flattened lower body terminating in a sizable but simple rounded toe (Figure 6). A tentative origin in northern Syria has been posited for broadly similar jars found in the north Sinai, and would seem to make sense on the basis of its limited distribution in very small numbers along the eastern Mediterranean littoral. Morphologically, the form fits broadly within the widespread bifid-handle amphora tradition

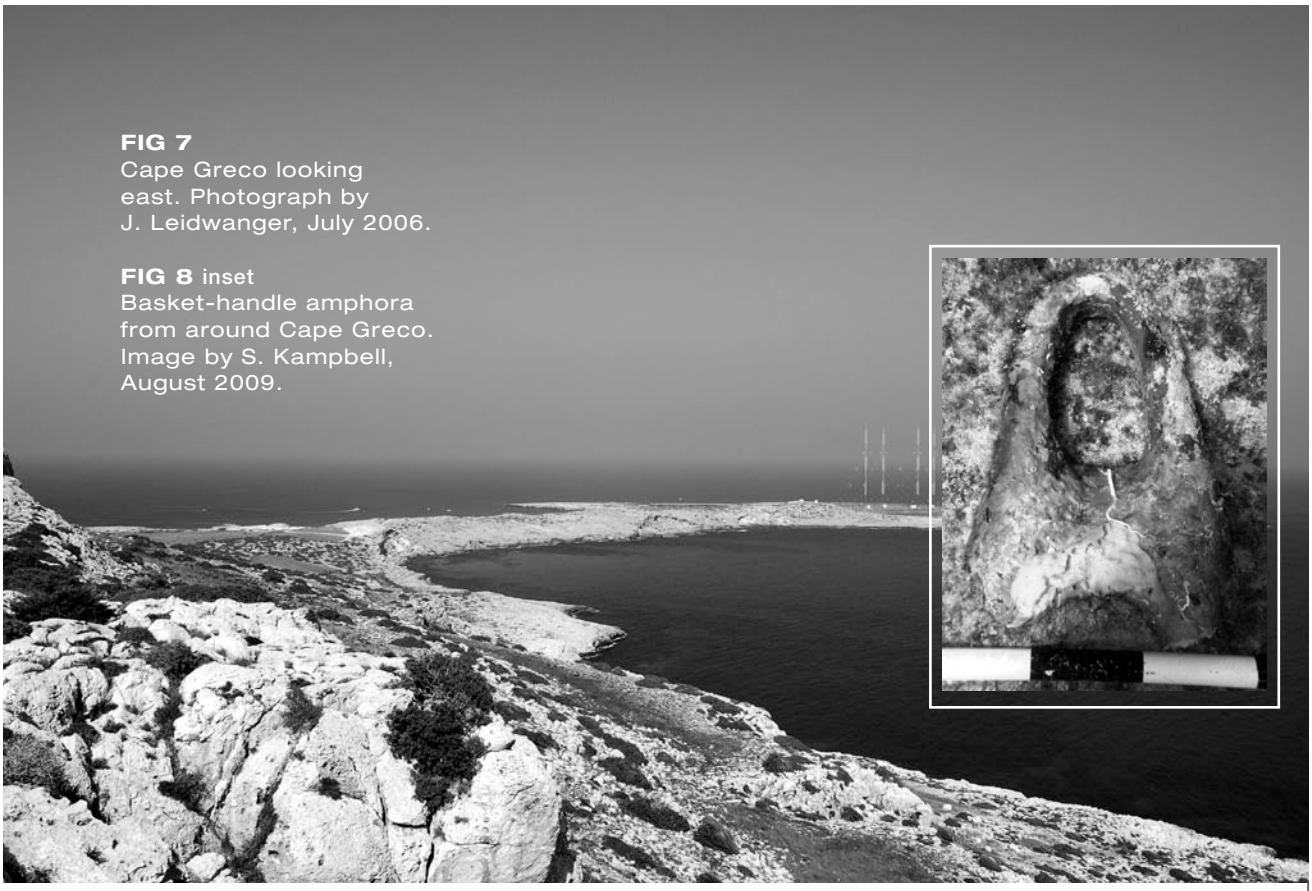

FIG 7
Cape Greco looking east. Photograph by J. Leidwanger, July 2006.

FIG 8 inset
Basket-handle amphora from around Cape Greco. Image by S. Kampbell, August 2009.

common during the early Roman era across the Mediterranean, and would be at home in a generally similar region to that producing the bifid-handle and carinated Agora M54 jars previously discussed. Even so, its appearance is uncommon and the present well-dated context represents a rare find of a type that has remained comparatively poorly understood. More comprehensive analysis of the fabrics could help elucidate a potential origin and in turn shed additional light on the regional connections evident in much of this ship's cargo.

The best evidence for the wreck's date comes from the amphoras raised for further documentation during the 2008 field season. While the widespread production of some Roman amphora types means that multiple variants can obscure highly precise dates, the Gauloise 4 group is sufficiently well-studied to yield a date for the wreck assemblage around the very end of the 1st century AD or early decades of the 2nd century. This suggestion fits well with the broad date for the Agora M54 amphoras.

Cape Greco

Although the Roman wreck provided the main emphasis for the 2009 field season, limited additional investigations were undertaken in the waters just south of Cape Greco (Figures 1 and 7). Systematic non-intrusive survey up to 20–25 m of depth resulted in new discoveries of anchors and ceramics, including some of the earliest datable material thus far recorded in the area: the remains of several Cypriot basket-handle amphoras perhaps Classical in date (Figure 8). In addition to providing evidence for local Cypriot commerce in olive oil or wine, their presence in several scattered examples may hint at a possible wreck with this cargo resting in deeper water, a target worth investigating in greater detail with divers and remote sensing. Far more common in the area are fragmentary ceramics dating to the Roman and Late Roman periods, including a lamp, the remains of Akko-type and other amphoras of Roman date, and the standard assortment of regional Late Roman forms, including LR1, LR4 and LR5/6 jars.

Although more problematic to date, several anchors provide complementary evidence for maritime traffic around the cape in antiquity. At least one unusual composite stone anchor was documented with only two holes: one presumably for a hawser and the other for a wooden fluke with which to grip the seabed. Two new small metal grapnel anchors were discovered, in addition to one larger example recorded in 2006-2007. Together with the simple stone weight anchors previously mapped in an inlet just to the west, this group

provides evidence for maritime traffic from perhaps as early as the Bronze Age through the Medieval period and perhaps beyond.

Preliminary Results and Plans for the Future

The only known shipwreck of its date currently explored off the shores of Cyprus, the Roman site near Protaras provides a potentially significant contribution to the history of maritime economy as well as regional and long-distance exchange within this province. While its overwhelmingly regional cargo would seem to indicate close ties to nearby Cilicia, the specific details of the ship's final voyage, its origin and destination, remain unclear. Its cargo raises a number of new questions. How did products from distant provinces—like wine in the Gauloise 4 jars—find their way into local patterns of exchange at secondary coastal settlements? What role might small-scale and short-haul coasting commerce have played in redistributing these exotic products alongside local and regional wares? What economic relationships bound eastern Cyprus to the neighboring mainland of Cilicia? How might the presence of imitation Gaulish amphoras speak to the marketing of different qualities and styles of wine in the Roman east? Both the shipwreck and stray finds underscore the busy commercial activity around the cape during antiquity, in particular for the Roman and Late Roman periods, when this corner of the island seems most closely tied to the nearby mainland.

Future plans will emphasize completing the comprehensive shallow-water survey in the Cape Greco region, particularly to the east and south of the headland and up to 30–40 m deep, where stray finds like the group of basket-handle amphoras may indicate a wreck. The flatter sandy seabed beyond the near-shore shallows also provides an ideal setting to extend surveys into deeper waters with remote sensing, as evidenced by cursory sidescan sonar test runs undertaken here in 2006. A balanced and comprehensive methodology combining shallow and deep-water survey along this stretch of coast promises could shed new light on long-term local maritime economic history, and the role played by Cyprus in regional and larger-scale Mediterranean trade.

Acknowledgements

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Illyrian Coastal Exploration Program The 2009 Campaign

Overview

Fieldwork along the eastern Adriatic coast in 2009 marked the initial campaign conducted and coordinated under the research initiative of the Illyrian Coastal Exploration Program (ICEP). The goals of the program, introduced in this

FIG 1
Overview of the survey areas for the 2009 field season.
J. Royal, RPMNF.

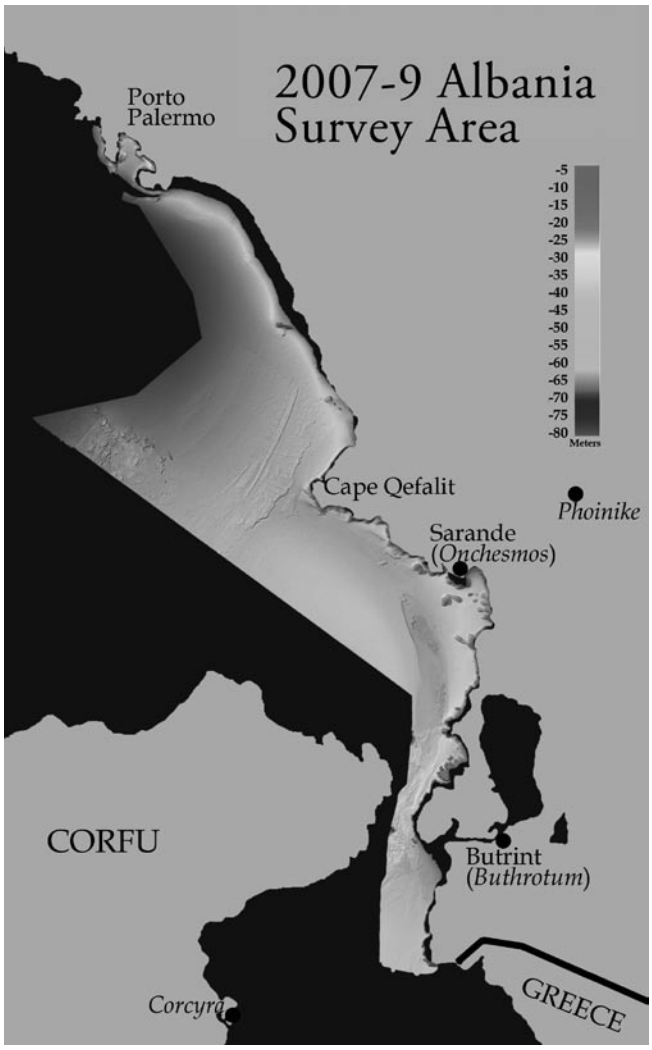


FIG 2
Multibeam coverage from 2007–9 in Albania Map by J. Royal, RPMNF

publication (Royal 2009), are to bring together numerous research institutes in an effort to investigate the eastern Adriatic coast. At the core of this program is a survey of the littoral region, out to the c. 100-m contour, spearheaded by RPM Nautical Foundation (RPMNF). The goal of the survey is to document all submerged cultural finds in an effort to assist the countries involved with the protection and scholarly research of these finds. This process is underway in Albania and Montenegro, and efforts are underway to organize fieldwork in Croatia for 2011. Among the entities involved in the program are the Albanian Ministry of Culture and Tourism, Albanian Institute of Archaeology (AIA), Butrint National Trust (BNT), Montenegro Ministry of Culture, Regional Center for Underwater De-Mining (RCUD), Montenegro Center for the Protection of Cultural Heritage (CPCH), Institute of Nautical Archaeology, Trinity University-San Antonio, U.S. Embassy-Montenegro. Efforts of many individuals make the program possible, among them are Dr. Adrian Anastasi (AIA), Co-Director in Albania, Auron Tare (BNT), Veselin Mijajlovic (RCUD), and Dr. Vilma Kovacevic (CPCH).

Survey Plan

Survey operations with a hull-mounted multibeam sonar were undertaken during May and June by RPMNF's R/V *Hercules*. Detailed bathymetric data was collected first in Albania then continued in Montenegro (Figure 1). Overlapping survey lanes along the contours of the seafloor ensured 200% coverage of the seafloor and the ability to detect anomalies. Anomalies were verified primarily with a Remotely Operated Vehicle (ROV) operated from the R/V *Hercules*, except for a few in shallow areas of c. 5-35 m of depth where divers were utilized in Albania. Once the research vessel was positioned over an anomaly location, the ROV was deployed. A forward-scanning sonar affixed to the ROV facilitated the location of each anomaly and aided in the examination of the area surrounding each anomaly for scattered objects. Each site or submerged find was recorded with the ROV's multiple video cameras. When deemed necessary, and conservation facilitates were available, objects were raised to assist in determining the date, provenience, and nature of the site or find. When geologic formations were encountered, they were scanned for cultural material that often is trapped when drag nets or currents push them onto rocks.

In addition to the multibeam survey, diver investigation was conducted in selected near-shore areas of Albania in order to gain an understanding of the presence of shallow-water material cultural. The dive team was expanded during the 2009 field season with the participation of volunteers from numerous organizations. Diver investigation included sections of coast all along the survey area. No beacons were attached to divers during operations; however, the locations of the dive boat, buoys placed at the furthest extents of the survey, and buoys at finds were recorded. Divers were armed with amphora

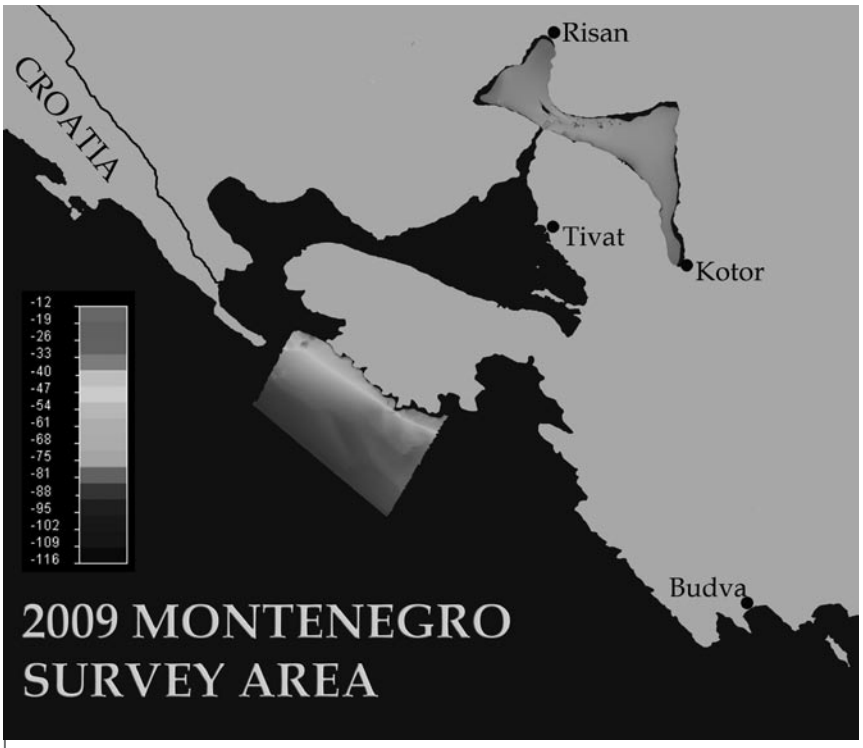


FIG 3 left
Multibeam coverage for 2009 in Montenegro. Map by J. Royal, RPMNF.

FIG 4 opposite
The Gjergantas Bank formation and position of the Joni wreck site in IVS Fledermaus; note the site's anomaly image in the lower left corner. Graphic by J. Royal, RPMNF

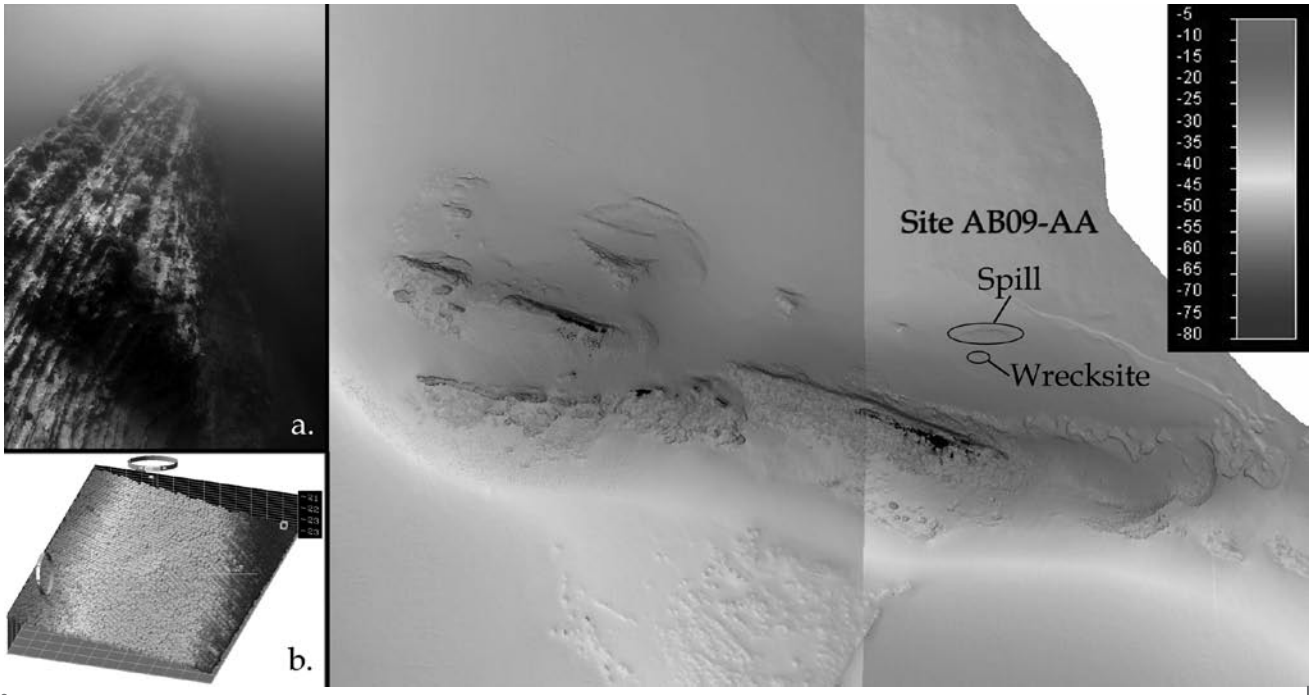
identification slates, still cameras, scales, and drawing slates for recording finds.

In Albania, the 2009 multibeam survey addressed gaps and unfinished areas within the section surveyed during the 2008 season, and subsequently continued northwards (Figure 2). From the southernmost point at the Greek border, the survey has progressed northward to Porto Palermo in three seasons, a distance along the coast of c. 50 km.[1] Once the operation progressed north of Corfu (Greece), it was possible to extend the survey area further offshore out to the c. 80–100 m contour. The survey plan formulated for Montenegro for this inaugural season was based on the areas of interest of RCUD and CPCH representatives, particularly the bays of Kotor and Risan (Figure 3). Founded in the 5th century BCE, the city of Risan includes remains from the Illyrian and Roman eras as well as the medieval period. Additionally, the survey of the outer coastline began with the area directly opposite the entrance into Tivat Bay (Boka Kotorska) and extended Cape Mačka. Combined the surveyed areas of Kotor and Risan Bays was approximately 28 km^2; the bays have a general depth of c. 30 m with a maximum of 60 m in spring holes. R/V *Hercules* approached very close to shore in some sections and also passed in depths as shallow as 12 m. The coverage area on the outer coast was c. 32.5 km^2 and ranged from 17–100 m.

Data from the multibeam operations was processed during, and directly after, the collection phase to produce three-dimensional models of the seafloor, which was then analyzed for anomalies.[2] Anomalies were examined for association with either geologic formations or deposits consistent with shipwreck sites, the latter were plotted for verification. Once mapped out in navigation and spatial recording software, the R/V *Hercules* navigated into position over anomalies and the ROV equipped with a transponder was deployed.[3] The software also allowed the real-time tracking of the R/V *Hercules* and ROV within a three-dimensional seafloor model, and to obtain precise locations for sites and random finds. During verification operations, the locating of each anomaly, as well as stray material near anomalies and sites, was facilitated by a forward-scanning sonar affixed to the ROV. Once cultural material was located and positions recorded, a visual investigation ensued through the use of still and video cameras. Scale was provided with a laser affixed to the ROV that provides two 10-cm spaced points.

Geologic Findings

After completing the processing of data acquired during 2009 in Albania, ands its collation with previous season's, the areas north of Saranda around Cape Qefalit and extending northward possess a large number of rock formations in the deepest sectors of the survey area. Some formations near the cape form linear patterns extending tens of kilometers, while the formations further from shore are more heterogeneous in size and pattern. These rock formations do not appear within 5–6 km of shore N of Cape Qefalit, where they are apparently buried under sediment layers. Ascertaining the possibility of rapid and massive geologic modification



of this area is beyond the scope of this report. However, once multibeam lanes were run in a roughly E-W direction (perpendicular to shore) just to the N of Cape Qefalit in order to adjoin the 2008 multibeam coverage, the surveyors noted that depths indicated on the current charts in use for this section of the Albanian coast were in error. Actual depths were much greater for the position on the chart; for example, areas recorded as c. 90 m of depth were actually 75-m deep. Hence, the area possible to survey is greatly extended from shore than was indicated during the planning phases of the field season based on chart data. This increased area requires a greater time commitment to complete; consequently the survey did not reach out to the 100-m contour in the Porto Palermo area. Coverage was completed to Porto Palermo out to the 40-50 m contour in order to allow room for vessel maneuvering and free the surveyors to plan the most efficient lanes for covering the area. This inconsistency between the depths indicated on the charts and the actual multibeam depths has two possible explanations: the charts are in error, or there has been a large amount of sedimentation in this area that has dramatically changed the seafloor topography.

Other evidence that indicates discrepancies in the survey for charting purposes and ICEP data is for the large rock outcrop near shore (Gjergantas Bank) that extends to within c. 2 meters of the surface in several places (Figure 4). This obvious navigation hazard does not extend to shore as indicated on charts. Recent work along the Croatian coast indicates the eastern shore of the Adriatic is undergoing subduction at varying rates. Combined with the sea-level rise over the past several millennia, submerged Roman-era structures indicate an overall rise in relative sea-level from 1–3 m. Given this difference in historical sea level, the Devil's Tongue formation must have presented a particularly dangerous navigation hazard in antiquity.

As noted above, the bays of Risan and Kotor were intensively surveyed to assess the potential for archaeological finds. A review of the data produced interesting results for understanding the nature of the seafloor. The bottom is at a consistent depth of c. 30 m, gradually decreases in depth at the towns of Risan and Kotor, and is composed of a soft, silt stratum on the surface. In the central portion of this bay system are numerous fresh-water springs fed from the surrounding mountains that rise to over 800 m. These springs maintain large craters formed in the seafloor with depths from 45–60 m, which demonstrate the vast amount of sediment deposited from the wash off the surrounding peaks. Tidal and circulatory currents as well as seasonal storm action move the sediment out of the bays to the coastal entrance where it dissipates southward down the coast.

Sites and Other Finds

Modern Sites

Three modern wreck sites were discovered during the 2009 field season, all of which are in the coastal section of Montenegro. A submarine (site MN09-AA) was partially buried in the silty bottom near the entrance of Boka Kotorska. This c. 30.5 x 7.0 m vessel

has large sections of the outer plating missing, some of which appears torn away. There are at least two torpedo tubes along the NE side of the vessel, a large hatch or gun emplacement positioned along the vessel's top at the NW end, and at the SE third is a likely coning tower. A review of the WWI and II-era submarines in the Maritime Museum in Kotor provided several good matches for dimensions and features.[4] A second military craft (MN09-AB), measuring c. 39.0 x 7.5 m, was discovered just south of the previously discussed submarine. It sits upright with a large amount of structure visible, although the remaining height of the structure is not great. A narrow length-to-beam ratio and metal construction indicates a swift vessel of the early-mid 20th century; it has similarities to the torpedo boats known to have operated in this area. The final modern wreck site (MN09-AC) is also a modern war vessel located near the previous two, probably constructed of aluminum, and has a shape consistent with a fast patrol craft. There are apparent blast holes at the bow and stern of this c. 38.0 x 8.5 m vessel. The wreck sits nearly upright at the fore section but twists to its port in the a-ft section where the bottom of the hull is visible. Poor visibility due to the sediment outflow from Boka Kotorska made identification difficult; yet it has many features of communist-era patrol craft, many of which were of Chinese manufacture.[5]

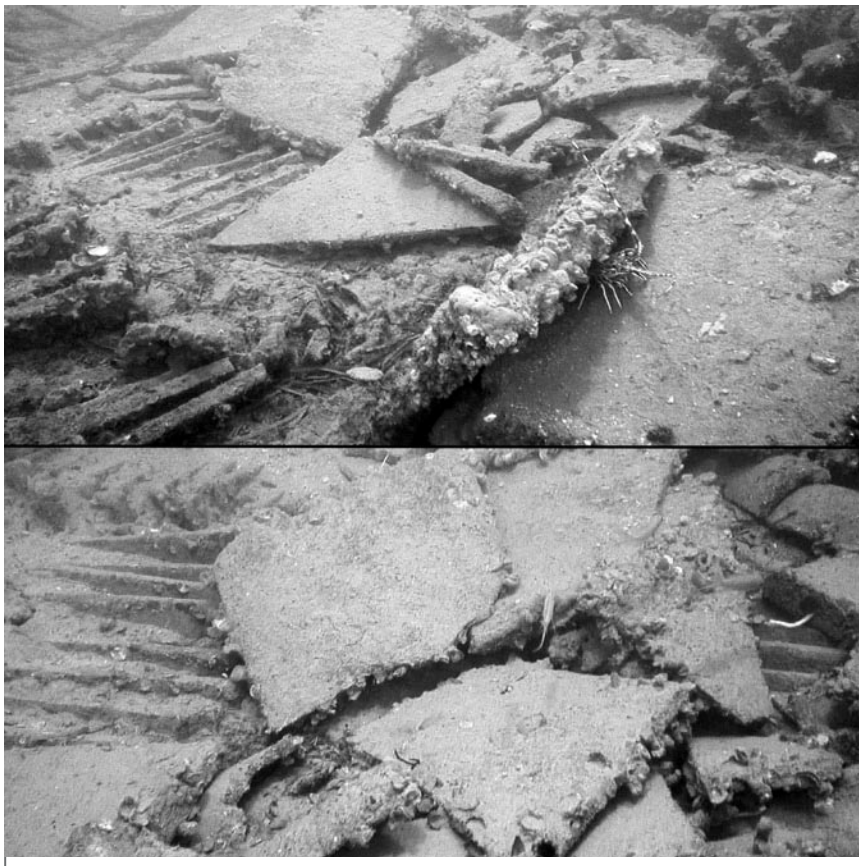
Ancient Sites

Verification of multibeam anomalies produced three Roman-era wreck sites, one in Albania and two in Montenegro. Considering the natural hazard presented by the Gjergantas Bank along the Albanian coast between Cape Qefalit and Porto Palermo, anomalies were carefully explored. Divers were used whenever possible due to the obvious hazard for the R/V *Hercules*. Examination of an anomaly at c. 23 m of depth on the inner side of the rock formation produced a

FIG 5
Divers recording the Joni wreck site. Photograph by D. Smith, RPMNF.

FIG 6 inset
An African 3C amphora on the Joni wreck site. Photograph by D. Smith, RPMNF.

FIG 7 opposite
Images of the Boka Kotorska 1 wreck site. Courtesy RPMNF.



well articulated and largely undisturbed wreck site: the Joni wreck (Figure 4-5; site AB09-AA). The principal portion of the site, a c. 9 x 4.5 m oval, is formed by 3–4 layers of intact amphoras. Approximately 20 m down slope of this primary deposit is a fan of broken ceramics that runs c. 15.5 m in length. No artifacts were raised for analysis during the season as it was decided that proper conservation facilities were not available. However, the shallow depth and good visibility allowed excellent image documentation and *in situ* measurements.

On initial examination, the cargo is primarily amphoras of type African 3A-C (Figure 6); however, there are also Late Roman 1 and 2 examples present as well. There is much variation in the rims within the three African 3 sub-type that often makes differentiation difficult; however, the intact examples provided additional identification traits such as the more slender bodies of the African 3C sub-type and the bulbous form on the base spikes of sub-type African 3A. The latter two types of Late Roman amphoras have an E Mediterranean origin and were present in the upper portion of the intact main deposit and the spill deposit, apparently loaded on top of the N African amphoras. As such, the preliminary assessment of the cargo origin is N Africa, probably Tunisian, with possible port calls along the western coast of Greece before it sank here in the 4th century CE.

The Joni wreck is one of two found in this project that date to the Roman or late Roman era, both with N African cargos; a supposed Roman-era wreck located north of the Butrint River mouth located in the late 1990s is un-substantiated. [6] A wreck discovered the previous season, site AB08-AH (Butrint 2 Wreck) carried Tripolitanian 1 type amphoras dated to the 1st–2nd centuries CE. One of the areas of inquiry raised by these two sites is the routes of goods moving from N Africa into the Adriatic. Routes from N Africa are traditionally believed to run along the S coast of Italy; however, these two Roman merchantmen point to another route through the straits of Corfu and, consequently, a more easterly initial route from the African coast.

One of the two Roman-era finds found in Montenegro was a somewhat large wreck site, a c. 25.0 x 7.0 m primary deposit, which features a cargo of roof tiles (Figure 7). The site is located approximately one km from shore in the open seafloor, and has undergone impact from fishing activities as evidenced by the large fishing net snagged on the tiles. Both flat pan tiles (tegulae) and curved cover tiles (imbrici) were present on the Boka Kotorska 1 wreck (site MN09-AD), the former were much greater in number. Many of the tiles remain in a stacked position, shifted as the wreck settled and decayed, and are intact. At least three long rows of tiles are noted running along the site's long axis.

A complete pan tile (Figure 8; artifact number MN09-0001) and a cover tile were recovered for documentation. The tegula was c. 63 x 47 x 2.5 cm, comprised of a dark red fabric and possessed flanges oriented at 90° to the flat pan surface. Notches cut into the flange's upper portion at the forward, and lower section of the rear, ends facilitated their overlapped stacking on roof tops. Both the tegula and imbrix were nearly iden-tical to ones recovered during dive survey along the Corfu Strait in Albania during this same season. Such tiles are difficult to date on their own, although there are assuredly stamped tiles within the cargo that would facilitate dating; however, they are of the form common to the early Imperial period.

Similar tile wrecks are fairly common in the shallow waters investigated thus far in Croatia. Tile production was minimal in the eastern Adriatic during the 1st–2nd centuries CE, the initial organization period under Roman rule. During this period, tiles were shipped into eastern Adriatic port cities to supply building projects. By the end of the 2nd century CE onwards, the local production of tiles was developed and

decreased overseas demand. Although it is impossible to determine the exact date and provenience at this time, the wreck was very possibly carrying tiles from workshops on Italy's Adriatic coast operating during the early imperial period, a time when heightened imperial family and senatorial involvement in the industry is recorded.

A second wreck (site MN09-AE) of the Roman era was located near the entrance at Boka Kotorska that carried a large shipment of amphoras (Figure 9). The Boka Kotorska 2 wreck site was somewhat spread out, 20 x 17 m, due to apparent hits by fisherman's drag nets. The amphoras in the central portion of the site have fallen in an organized pattern from their stacking arrangement and are mostly intact; many are buried to a large degree. Those amhoras on the outer sections of the wreck are damaged with numerous sherds scattered around, their orientations are inconsistent, and often sitting more atop the sandy seafloor. It would seem that some of these amphoras were dislodged from a more organized deposit and damaged by drag nets. Based on the visible amphoras, the majority, if not all, of the cargo is of Lamboglia 2 amphoras that date from the early through end of the 1st century CE. A single amphora was raised for analysis (Figure 10; artifact number MN09-0003). Although marine growth rendered them unreadable upon recovery, a rectangular stamp is located on the lip and the stopper that remains in place has relief lettering and/or designs; this stopper also had a center knob. Similar stoppers, published by CPCH, have been found in Risan and Kotor bays. Likewise there are examples of Lamboglia 2 amphoras in the Kotor Maritime Museum and the Lady of the Rock Museum in the center of the bays. This wreck carrying Lamboglia 2 amphoras, particularly those with this type stopper, was likely enroute from somewhere in central Dalmatian coast, as recent research indicates this was the production area for this type particularly at Vis and Narona in Croatia.[7]

FIG 8
Roman tegula from the Boka Kotorska 1 wreck site. Photograph by J. Royal.

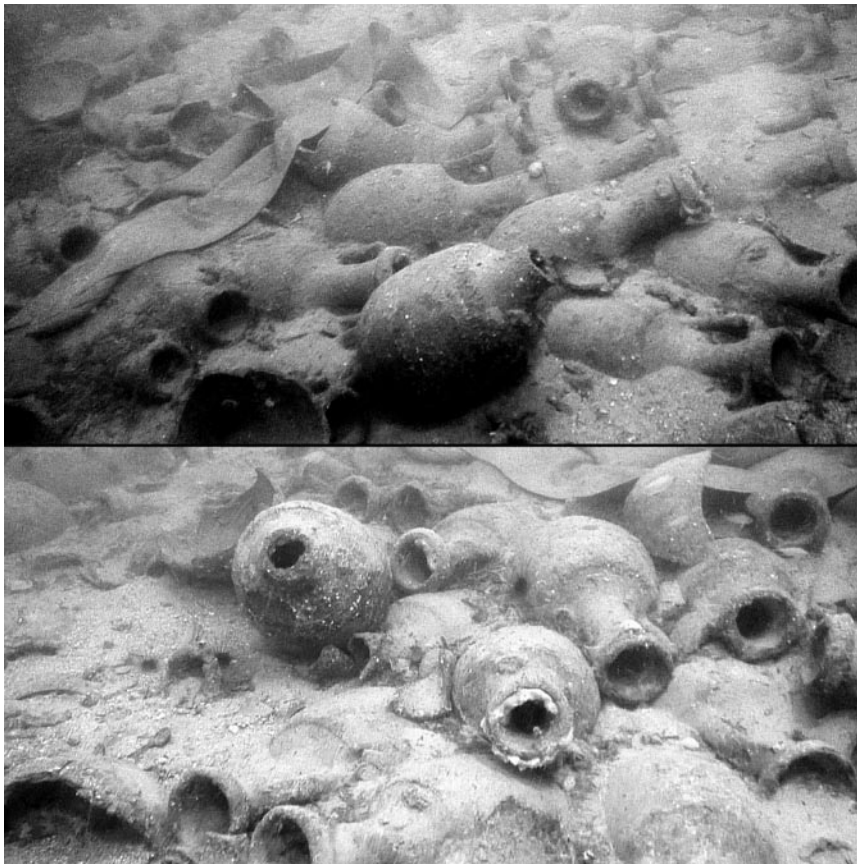


FIG 9
Images of the Boka Kotorska 2 wreck site. Courtesy RPMNF.

Current work in Risan and Kotor Bays is more difficult. There were 55 total anomalies in both bays and their investigation indicated geologic formations or modern debris. ROV operations were also conducted near Risan along the eastern shore where amphora fragments have been reported. Several amphora fragments and a possible whole buried amphora were located in the area, but no other finds were made in a wider search. Likewise, the multibeam data showed no evidence of architecture above the surface in the area where the ancient city of Risan purportedly sank into the bay.[8] From the bottom conditions observed, it is clear that a large amount of sediment has buried ancient finds, and what has not been buried has been taken by the many years of looting in the bays. Local reports indicate the Yugoslavian army posted divers here for decades who had little to do but collect artifacts in the shallow bays. Other reports indicate individuals conducted regular looting of the bays as an illicit business in trafficking artifacts or selling 'antiques'. This situation underscores the necessity for a comprehensive survey of Montengro's submerged cultural resources as part of an overall management and protection strategy.

Supplementary Wrecksite Efforts

Along with ROV operations to verify anomalies in Albania, two sites discovered in the previous season were visited for mapping with a new camera configuration and the use of new lights attached to the ROV's deployment cage. Both the Rodon wreck (AB08-AF, late 6th–5th BCE) and the Qefalit Tile wreck (AB08-AG, 4th BCE), which carried Corinthian cargos were video recorded. Given the additional lighting and camera configuration, the imagery improved from the previous season and it was possible to develop a workable photo mosaic for producing site plans. Additional amphoras were noted on the Rodon wreck protruding from the mud. To further the analysis of the Qefalit Tile wreck, an additional flat tile and the first cover tile were recovered from the site. This second pan tile collected from the site was intact, unlike the one from 2008, and measured c. 81 x 51 x 2.3 cm. It was found flat on the seabed with its upper surface settled into the sand. Upon recovery it was noted that its upper surface that was pushed into the sand was covered with heavy, older shell growth that was now deceased, while there was much less growth on the exposed bottom surface. Hence, the tile was relatively recently moved from the pile, perhaps the last 10-15 years, and flipped over onto the seabed; the dragnets in this area and at this depth are the most likely mechanism to have causee this disturbance.

Additional photos and measurements were taken of the amphoras at the Butrint 2 wreck site (AB08-AH, 1st–2nd CE) in Albania, and investigation revealed more of the amphoras were visible than in the previous season; perhaps the different time of season incurs sediment removal at this time. The additional fragments were consistently of type Tropolitanian 1, the only type noted at the site thus far. Although it is not certain, a fragmentary African-type cylindrical amphora located some 100–125 m to the N of the site may be a Tripolitanian 1 as it exhibits a constricted waist and a similar toe. Supplementary video was taken of a modern site discovered in Albania in 2007 as part of an investigation into the remains being that of the *Volage*, a British warship damaged in the area in 1946. Its archaeological investigation is lead by Dr. Delgado of INA and a preliminary report has been published.[9]

Shoreline Dive Survey–Random Finds

Over the course of the field season in Albania a dive survey was conducted along the shallow waters of the shoreline. Areas were defined by weather, accessibility, time constraints, and experience from the previous two seasons. As such, the coverage was neither systematic nor fully based on random sampling; hence, some statistically-based conclusions are difficult to draw. However, the significant area covered over the past three seasons, and that all sections of the coast in the survey area have been explored, do provide a useful sample. The remains are likely the primary result of jetsam as ships passed into and out of the Corfu Straits; hence they present themselves as random finds on the seafloor. The lack of recreational diving in Albania has maintained this record of random finds, one of the few places in the Mediterranean where such finds survive at diver depths. A few other random finds were discovered during ROV operations, yet the majority were documented in dive operations.

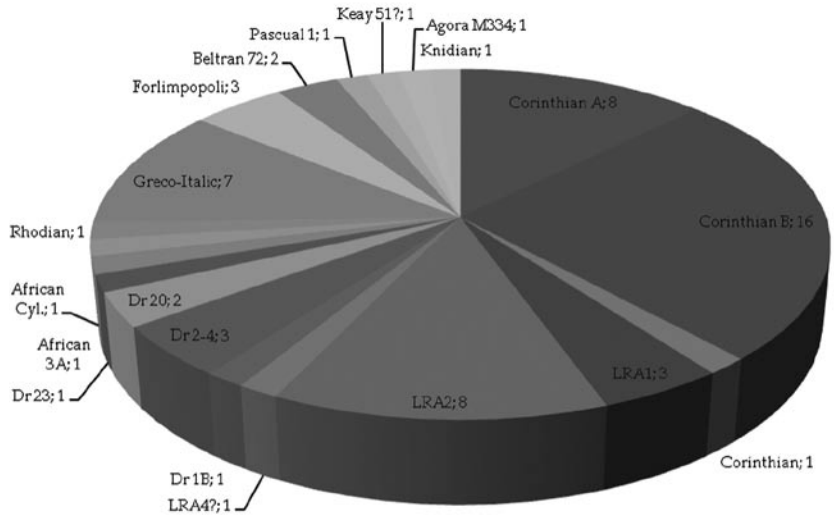
A majority of random finds are either intact, or nearly intact, amphoras and were located from the Greek border to the southern end of Sarande Bay, particularly south of the entrance to Butrint. In addition to amphoras,

FIG 10
Lamboglia 2 amphora from the Boka Kotorska 2 wreck site.
Photograph by J. Royal.

tableware from many eras is frequently encountered as well as various lead anchor stocks. Finds in Sarande Bay were scanty, and from the nature of finds from the late medieval and later periods, it appears that heavy silting in this bay has buried much of the earlier evidence. All random finds of amphora types are provided in Graph 1. Corinthian amphoras were the most commonly found, and type B Corinthian amphoras were twice as prevalent as type A. Late Roman amphora types were also common finds as were Greco-Italic amphoras from the Hellenistic era.

The numerous examples of Corinthian amphoras speaks not only to the primary route through the Corfu Straits for merchantmen carrying goods further north, but also suggests this traffic was heavy and of a long duration. These finds underscore the evidence provided by the five shipwrecks carrying Corinthian goods thus far discovered. Within the long history of this traffic, both sets of evidence indicate the heaviest shipping during the 4th–3rd centuries BCE. This is also the period where a significant representation of Greco-Italic amphoras is noted in the sample.

Whereas amphoras produced in the Adriatic such as Lamboglia 2/ Dressel 6, and Forlimpopoli types are common finds along the Croatian and thus far on the N Montenegrin coasts, only the Forlimpopoli type amphoras are well represented along the southern Albanian coast. During the 2nd–3rd century CE, Forlimpopoli type amphoras are common at Butrint, Durres and a number of E Mediterranean sites where their directed shipment was predominant. The working theory is this differentiation in finds is based on routes. Whereas ships coming out of the Adriatic heading east, commonly those carrying Forlimpopoli amphoras, would come through the Corfu Straits, while those merchantmen carrying Lamboglia 2 amphoras were headed more often to W Mediterranean ports and therefore crossed over to S Italy before reaching Corfu. Ships with Lamboglia 2 amphoras could run the eastern coast of the Adriatic to a point near Apollonia before crossing over to Italy; hence, further documentation of finds is crucial as the survey continues in both Albania and Montenegro.



Graph 1. Amphora types discovered during diver survey, 2007–9.

Bio-Archaeology Research

In an effort to increase the ICEP's scope, the addition of innovative biological research into marine archaeological sites is sought. Marine biological research will focus upon biological community structure and diversity of submerged cultural sites in the study area that vary significantly from one another as well as provide comparative material for those in surrounding areas. Continuous measurements of salinity, pH, and dissolved oxygen will be taken at selected sites, and when possible will also include light levels, current profiles, wave height, and tidal range. The study will also utilize the placement of recruitment plates for obtaining colonization data on ancient wreck sites, the first of which is the Butrint 1 wreck site in Albania. Collected data will allow for inter-site comparison, establishment of a baseline for the monitoring of sites, and factor into protection and management decisions. It is envisioned that such participation of marine biologists and oceanographers will lead to recommendations and implementation of management plans for marine protected areas that include heritage sites. This effort is led by Derek Smith, who is currently finishing his MS at University of Hawaii's Zoology Department. Mr. Smith will be entering the Biology Department's PhD program at the University of Washington in the fall of 2010, and is an RPMNF/ICEP research associate. His focus is the study of biological communities specifically associated with submerged cultural resource sites and is at the intersection of ecological, archaeological, and oceanographic disciplines.

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Notes

1. During the 2008 field season the bay of Porto Polermo and its entrance was completed.
2. Multibeam data was acquired through Kongsberg's SIS software, processed in CARIS HIPS/SIPS, and modeled in IVS Fledermaus software for anomaly analysis. All acquisition and processing of data was performed by surveyors contracted from Highland Geo Solutions Inc. of Fredericton, NB, Canada.
3. IVS kindly provided a prototype software module that allowed the tracking of all vessels within the 3-D models of the seafloor in Fledermaus.
4. Although it is not clear from the evidence if this was the scuttled Austro-Hungarian submarine U-72, the German U-24, or whether a British submarine (possibly the H2) that was also lost in the area.
5. Not only were modern war craft a common find, but a spent missile was also found in target confirmation. There have been many tons of munitions from the various 20th-century conflicts removed from Montengro's waters by the RDMC; however, all of the finds discussed here were at depths over 60 m.
6. The heavy concentration of Roman and Late Roman-era amphoras littering the seafloor, some of which are intrusive on Archaic-Hellenist Greek wreck sites, probably led to confusion.
7. Lindhagen 2009.
8. If it did recede under the water due to sea-level rise and possible subduction, then heavy sedimentation has long covered any remains; some of Risan's ancient remains are reported to have been build over when the new dock at Risan was completed.
9. Delgado 2009.

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Revisiting and Early Naval Incident of the Cold War: Archaeological Identification of the Bow of HMS *Volage* Sunk During the Corfu Channel Incident of October 22, 1946

HMS *Volage*, from Pingbosun, Destroyers Second Album, Picasa.

Volage, in harbor, showing bow damage, from Pingbosun. Destroyers Second Album, Picasa.

Introduction

Following the Second World War, Britain asserted that the Corfu Channel, a narrow seaway separating the island of Corfu from the Albanian coast, was an international strait. Albania, at that time a Communist State under the leadership of Enver Hoxha, came into conflict with Britain over the right of passage. Three separate incidents ensued in 1946. Britain claimed free transit through an international waterway, citing the doctrine of innocent passage, and Albania

claimed that in all three incidents the passage was anything but innocent and that Albanian sovereignty had been violated. Following the last two incidents, one of which involved loss of life, the two nations agreed to settle the matter in international court. In a now famous legal decision, the Corfu Channel Case, the court found for Britain, but acknowledged that in the third incident Albanian sovereignty had been violated.

The court decision did not resolve the matter to the satisfaction of either party. Britain and Albania severed diplomatic relations, and did not resume them until 1991. The incident remains controversial to this day, with unresolved questions. A comprehensive archaeological survey of Albania's coastal waters by the RPM Nautical Foundation, Inc., encountered the remains of what was identified as a modern shipwreck 1.5 kilometers off Saranda in Saranda Bay in 2007. At the request of the senior author in 2009, during survey operations in the vicinity, the "modern wreck" target was revisited and examined with an ROV. The archaeological evidence suggests that the target represents the remains of the bow of HMS *Volage*, blown off by mines during the Corfu Channel Incident of October 22, 1946. Additional survey and study of the target is recommended, particularly as the survey encountered what may be human remains.

Hull remains on site, with blast hole. Photograph courtesy RPM Nautical Foundation.

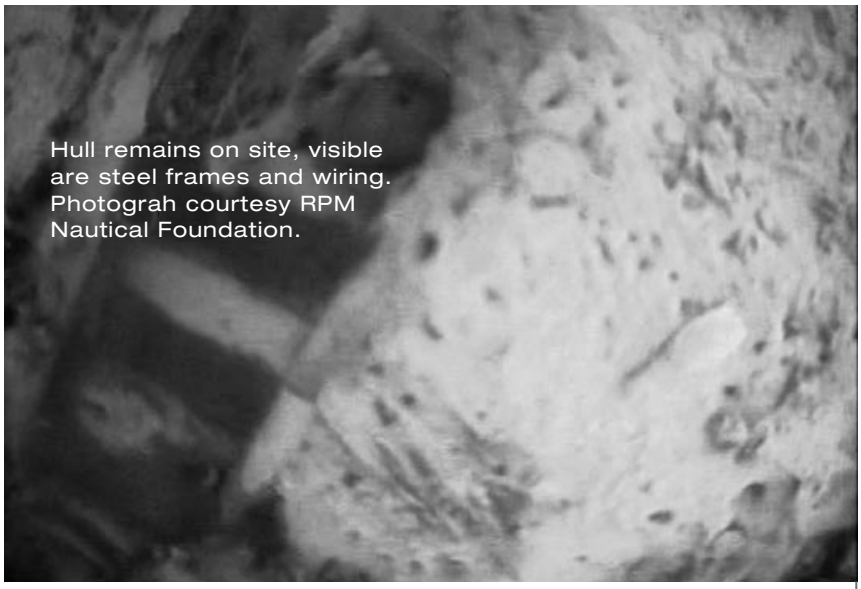
Historical Background

The straits that separate the island of Corfu from the mainland are a narrow channel approximately three nautical miles across that widens past the town of Kassiopi on the northeastern end of Corfu. The channel or strait has been used for millennia as a route for ships entering the Adriatic from the Ionian Sea and conversely ships leaving the Adriatic. The international boundary between Albania and Greece is defined as the middle of the channel (approximately 1.5 nautical miles off each coast) on navigational charts. As a key transit point between two oceans, the Corfu Channel became a strategic choke point during the Second World War, when the straits were mined by the Axis. In 1944 and 1945, British minesweepers cleared the channel to reopen the straits. The Royal Navy maintained a fleet anchorage off Corfu Town, and viewed the channel as "an international highway." This view and British naval activities in the area led to conflict and eventually the near-loss of two British warships and the death of 44 British seamen.

This event, known as the "Corfu Channel Incident," occurred during a time one historian has termed the "confused aftermath of World War Two, when Britain was attempting to re-establish its status as a major maritime power and undertake its duties in the Mediterranean," which included mine clearance and reopening the Corfu Channel to international traffic as well for its own warships.[1] Britain operated on the legal principle that the channel was an international passage, and its navy was "reaffirming customary law".[2] Albania, however, viewed the straits as a sensitive area vital to the "security of the country and its recent hard won independence". [3]

Enver Hoxha, the Communist leader of Albania, was "highly suspicious of his Greek neighbors" because of years of conflict over the boundaries of Greece and southern Albania, including open warfare after 1940. The end of the Second World War did not alleviate Hoxha's concerns, and Albania was "at a high state of alert and coastal batteries overlooking the Corfu Channel were constantly manned because Greek ships, including warships, frequently approached close to the Albanian shore of the channel".[4] As one historian has noted, this may have been because the median line and the international channel are not ideal for larger vessels due to the "shallow, rocky, and shelving nature of the seabed on the Corfiot side" and as a result "ships using this route were forced to navigate within a mile of the Albanian coast".[5]

Whether the British view and subsequent actions were provocative or not is essentially a moot point. Hoxha and by extension Albania considered it provocative and acted accordingly. In addition to the issues between Albania and Greece, and Britain's acknowledged friendship with Greece, the tensions between the United Kingdom and Albania were part of an escalating series of encounters between various Communist states and non-Communist states that began in late



Hull remains on site, visible are steel frames and wiring. Photograh courtesy RPM Nautical Foundation.

1945 and continued over the next four decades as part of the "Cold War."

Following elections in December 1945 which gave Enver Hoxha and his party a mandate to form a government, Hoxha created a Communist monopoly and began to take an increasing number of anti-western actions. In February, 1946, the Fifth Plenum of the Central Committee of his party, the CPA, decided that "Britain and the U.S. represented the main danger to national [Albania's] independence".[6] Accusations of espionage and economic sabotage and a trial of pro-western Albanian parliamentarians led to a British withdrawal of its military mission in April 1946, and cancellation of an exchange of diplomats.[7]

On May 15, 1946, two Royal Navy cruisers, HMS *Orion* and HMS *Superb*, the first British warships to use the Channel since the end of the war, entered the northern end and steamed south off the Bay of Saranda toward Corfu, where they planned to anchor. As they passed close by the coast, several shots were fired with high explosive shells. The cruisers picked up speed and the shots fell astern.[8] No hits were scored, and the cruisers did not return fire, but Britain demanded an official apology, which was not granted. Hoxha claimed that his shore batteries had defended Albanian from a planned British landing.[9] As one historian has noted, "despite an understandable degree of determination by a small nation that felt under threat from more powerful neighbours to defend itself, what was at stake was the balance between sovereign rights and the freedom of navigation through the waters in the Corfu Channel".[10]

Britain then decided to assert, through a larger naval presence, that they had the right to transit the channel. As Thomson (2005), notes, the Albanian response to Britain contested that assertion, and "perhaps, understandably, the Admiralty had taken umbrage" (150). A dispatch was sent to the Commander-in-Chief, Corfu:

> The establishment of diplomatic relations with Albania is again under consideration by H.M. Government who wish to know whether the Albanian Government have learned to behave themselves. Information is requested whether any ships under your command have passed through the North Corfu Strait since August, and, if not, whether you intend them to do so shortly.[11]

While no specific instructions were given by the Admiralty to the C-I-C,, the intent "was clear enough," and the C-I-C decided to route four of his ships through the channel to "make a diplomatic and legal point".[12] The vessels were the cruisers HMS *Mauritius* and HMS *Leander*, accompanied by the destroyers HMS *Saumarez* and HMS *Volage*. The four vessel force entered the "North Corfu Channel" on October 22, 1946. HMS *Saumarez*, and subsequently HMS *Volage* (while attempting to tow *Saumarez*) struck mines which seriously damaged both vessels and killed 44 of their crew, wounding 42 others.

Britain protested and announced that it was sending more of its ships into Albanian waters to clear them of mines, which it did on November 12 and 13. The UK submitted the matter to the United Nations Security Council for adjudication. The key arguments were Britain's assertion of their warships' presence off the Albanian coast as an "exercise of the right of innocent passage," and the argument that Albania had laid the mines or had cause to know of the mines being laid by a third party and thus were in violation of international law and liable. Albania's claim at the time of adjudication was that "It has not been proved that the mines which caused the accidents of October 22nd, 1946, were laid by Albania," it "has not been proved that these mines were laid by a third Power on behalf of Albania," that it "has not been proved that these mines were laid with the help or acquiescence of Albania," and that "it has not been proved that Albania knew, before the incidents of October 22nd, 1946, that these mines were in her territorial waters." Albania also contended that the U.K. "violated the sovereignty of the Albanian People's Republic by reason of the acts of the Royal Navy in Albanian waters on the 22nd October and on the 12th and 13th November I946,"

and that Albania, as a "coastal State is entitled, in exceptional circumstances, to regulate the passage of foreign warships through its territorial waters. This rule is applicable to the North Corfu Channel."[13]

The matter ultimately was submitted to the International Court of Justice at the Hague, and resulted in nearly three years of proceedings which ultimately were decided in Britain's favor, although the Court ruled that Albanian sovereignty had been violated in the mine clearance action of November, when the sweeping came as close as 300 yards offshore.[14] Albania was ordered to pay £875,000 in restitution to the United Kingdom, which it refused to do. Britain then froze Albanian gold assets held in London. Diplomatic relations between the two nations were not normalized until 1991, with the "Corfu Channel Incident" remaining a matter of disagreement.

HMS *Saumarez* and HMS *Volage*

Both of the ships damaged with loss of life during the Corfu Channel Incident were destroyers with distinguished careers and battle honors. They were the product of a wartime build-up of British destroyers, specifically of the "utility type" in which "essential war requirements took precedence over all other considerations," namely they were utilitarian, no-frills vessels.[15] HMS *Saumarez*, an "S" class destroyer, was laid down at the Hawthorn Leslie yard, Hebburn, Newcastle-upon-Tyne. Launched on November 20, 1942, *Saumarez* was commissioned on July 1, 1943. HMS *Volage*, a "V" class destroyer, was laid down at the yard of J. Samuel White, Cowes, on December 1, 1942, launched on December 15, 1943, and completed on May 26, 1944.

TABLE ONE: Tonnage, Dimensions and Armament (as launched)

	Saumarez	*Volage*
Displacement	1730 tons	1777 standard
Length	363 ft (111 m)	363 ft (111 m)
Beam	35 ft (11 m)	35 ft 8 in (11 m)
Draft	14 ft (4.3 m)	10 ft (3.0 m)

Armament for each at launch

Four QF Mk XII 4.7 in (120mm) guns in single mounts CP Mk XXII
Two QF 40 mm Bofors in twin mounts Mk IV
Six QF 20mm Oerlikon guns, two in twin mounts Mk V and four in single mounts Mk III
Two quadruple tubes for 21 in (533 mm) torpedoes, Mk IX[16]

Following the Corfu Channel Incident, both destroyers successfully reached Corfu, and subsequently were sent to Malta. No known attempt was made to salvage or recover material from the bow of *Volage*, which sank at the site of the mine explosion. *Saumarez* was written off as a constructive loss and sold on September 8, 1950, and was reported scrapped in October 1950. *Volage*, after initial repairs, returned to the U.K. and was rebuilt as a Type 15 frigate in 1952-1953. Laid up and reported by some sources as scrapped in 1965, *Volage* was sold for scrap (some accounts say sunk) on October 28, 1972.[17]

Mining and Damage to *Saumarez* and *Volage*, October 22, 1946

In the absence of after action reports and official surveys of the damage to both destroyers, I have relied on a secondary source[18] which is based on interviews with surviving crew members from each vessel, as well as the submissions made by the U.K. to the International Court of Justice (1949).

After steaming from Corfu at 13:30 on October 22, 1946, the destroyers and the cruisers approached Kepi Denta (Denta Point) at the southern edge of the Bay of Saranda. At 14:47, the lead ship, HMS *Mauritius* signaled a port turn and a new course of 310 degrees. A reconstructed track course in Leggett (1976:36) depicts the turn outside the bay while Meçollari (2009:96-99) reconstructs the turn past the point and inside the bay. At 14:53 hours, while underway on this new course, HMS *Saumarez* struck a mine, later determined to be a German EMC (GY in British nomenclature) contact mine of World War II manufacture. The EMC was a spherical weapon 44 in (1.12 m) in diameter with seven Hertz horns (a German-invented chemical detonator that closed the circuit for firing) with a charge of 661 lbs (300 kg).[19] The blast occurred a few feet forward of the bridge on the starboard side, opening an approximately "thirty-foot section ... from the keel to just below the bridge" to the sea.[20] *Saumarez* stopped and began to drift, with a fire from spilled fuel engulfing the bow area as the bow, flooded from the explosion damage, settled beneath the surface. HMS *Volage* approached to assist and take *Saumarez* in tow. After one failed attempt (the line parted) a new towline was secured and *Volage* proceeded to tow *Saumarez* at 15:30.[21]

At 16:06 (or 16:15, according to Leggett), *Volage* struck a second mine. That mine was also later determined to be a German-manufactured EMC. *Volage* reportedly hit the mine head on; "In a split second, forty feet of the destroyer, from the fore peak to just in front of 'A' gun turret, had vanished. Mess decks, store rooms, the paint shop, the cable locker containing tons of anchor cable, the anchors themselves, literally dissolved in the air".[22] Fragments of the bow

Section of hull with welded fitting. Photograph courtesy RPM Nautical Foundation.

Plates and other ceramics. Photograph courtesy RPM Nautical Foundation.

were observed flying into the air, and other fragments, "some weighing up to half a ton" landed on the ship, some on to the bridge.[23] Leggett (36) and Meçollari (96-99) chart the site of *Volage*'s mining off the north point of the Bay of Saranda. As previously noted, despite their damage, both destroyers remained afloat, and subsequently returned to Corfu under tow. *Saumarez* suffered 36 dead, 25 of whom were missing and presumed killed, while *Volage* lost eight men, seven of whom were missing, presumed killed.[24]

Survey Operations and Identification

In July 2007, the RPM Nautical Foundation, a U.S. and Malta-based not-for-profit organization, began a comprehensive, ongoing archaeological survey of the coast of Albania in cooperation with the Albanian Institute of Archaeology (AIA) and the Institute of Nautical Archaeology (INA). The inaugural season, conducted from the R/V *Hercules*, involved a multibeam sonar survey with remotely operated vehicle (ROV) assessment of targets to the 120 m contour. The area surveyed was from the border with Greece, through the Corfu Channel (but not into Greek waters) and to the Bay of Saranda, 21 km from the border. A total of 125 anomalies were encountered, and 67 were assessed with the ROV during the 2007 season. The majority of anomalies were found to be geological mud and mud/sand formations created as silt from the mouth of the Butrint River to the south is transported by current in a N-S direction. Fifteen shipwrecks were identified, fourteen of which were classified as "modern" and one of which was an ancient wreck of ca. 300–275 BCE. One of the fourteen other targets, briefly examined in 2007, was later (2009) determined to be the bow of HMS *Volage*.

During the 2009 field season the sonar target in this area was re-examined by the authors, ROV specialist Kim Wilson, and George Robb, Jr., President and founder of the RPM Nautical Foundation, who immediately assessed the potential of the 2007 "wreck" as the possible bow of *Volage* in response to Delgado's question of whether the surveys of 2007-2009 had encountered any traces of the Corfu Channel Incident. After consultation with Anastasi as the AIA and Albanian government representative, it was decided to non-intrusively reassess the site on June 28, 2009. An hour-long ROV dive was made to the site on that afternoon. The water is turbid and full of silt and hence it was dark; making visual observation less than ideal.

The site is located in the area of the position provided by Leggett and Meçollari for the mining of

HMS *Volage*. The seabed is a loose mud and silt. The sonar anomaly delineated by multibeam in 2007 and reconfirmed in 2009 is approximately 15 by 10 m in area and has a height of 1.5 m above the current level of the seabed. Active siltation and burial of the vessel remains at the site is visible. Some localized scouring and uncovering of cultural material is also possible. The majority of the remains visible were a section of a steel ship's hull, with explosion damage consistent with an implosion, exposed steel frames, electrical wiring, and a series of diagnostic artifacts. While identification of the site would have been better aided by the recovery of one or more diagnostic artifacts, because of the possibility of the site being the bow of HMS *Volage* and hence a war grave, no disturbance was planned and nothing was disturbed or removed from the site.

The principal features observed during the ROV reconnaissance, as time marked on the appended DVD of the "down camera" are as follows:

1. A small locker or watertight shipboard enclosure (such as for a control), at 10:09 minutes.
2. The end of a welded attachment to the steel hull, at 10:32 minutes.
3. Steel pipe, at 10:51 minutes.
4. Blast damage to the hull (note the bent and torn steel), at 11:04 minutes.
5. Another view of the round hole in the hull, at 11:13 minutes.
6. More blast damage, at 11:48 minutes.
7. White ceramic dishes and a carafe, at 12:16 minutes.
8. An exposed canteen at 12:28 minutes.
9. More plates, at 12:58 minutes.
10. Possible bone, at 13:46 minutes.
11. Ammunition, some in clips, appears to be .303 caliber, at 25:46–26:25 minutes.
12. A hole in the steel hull, with visible frames and electrical wiring, at 24:08 minutes.
13. Another view of the ammunition at 26:49 minutes.

At this stage in the dive, the ROV moved off to examine a second anomaly, previously not assessed. No cultural material was visible, only mud. After an inspection of that area from 33 to 49 minutes into the dive, the ROV returned to the first site.

14. The sole of shoe or boot, at 30:24 minutes.
15. A canteen, at 31:37–32:17 minutes.
16. The ammunition, previously noted, at 49:11 minutes.
17. A steel girder of beam, blast affected, at 54:20 minutes.
18. A bottle or carafe, at 54:41 minutes.
19. The dishes previously seen, this view including mugs and a carafe, at 55:02 minutes.
20. Another shoe or boot, at 55:27 minutes.

The ROV dive concluded at this point and the ROV returned to the surface as the wind was building and sea conditions were less than optimal.

Based on the visual evidence, the cultural material at the site has been identified as the remains of the bow of HMS *Volage*, separated from the hull and sunk as a result of the mine explosion of October 22, 1946. This identification is based on the following factors:

A. The location of the find corresponds with the historically reported position of HMS *Volage's* encounter with the mine;

B. The size of the visible frames and structure are incongruous; i.e. the frames are too large for a 40 foot long steel vessel and suggest that the wreckage is a portion of a larger vessel;

C. The remains at the site are those of an explosion damaged section of the steel hull of a naval or military vessel, with electrical wiring, indicating a 20th century origin;

D. The style of the ceramic dishes is consistent with British Royal Navy crew mess issue of the Second World War period; the dishes are in close association and several were deposited on the seabed together in a stack. The bow area of HMS *Volage* included the forward mess of the crew and the ship's stokers;

E. The small locker, box or container is consistent with a military or naval vessel's construction;

F. The WWII British-issue canteen;

G. The ammunition, while not recovered for closer analysis, and not clearly observed, generally conform to the shape of British .303 round, in clips, and HMS *Volage*, if like other British destroyers, carried both .303 Lee-Enfield rifles and machine guns which utilized the .303 round (Campbell 1985:80);

H. The shoes would indicate that the site represents an area of the ship where personal effects and clothing were stowed (as was the case with the forward mess areas of *Volage*), or that shoes associated with crew who were in the area at the time of the sinking are on the site.

In conclusion, while no artifacts were disturbed, excavated or recovered to facilitate identification, the nine points of evidence suggests no other alternative than that this site represents the remains of the bow of HMS *Volage*, and that this site is a war grave. While the vessel remains are within Albanian territorial waters, the identification of them as being from HMS *Volage* indicates a distinct legal status as the sovereign immune

property of the United Kingdom.

This report, with the dive footage from the ROV inspection, has been provided to the Government of the United Kingdom and the Government of Albania. The Corfu Channel Incident remains a subject of interest and controversy in both the U.K. and Albania. The archaeological identification of the bow of HMS *Volage* now provides exact coordinates for the second part of the incident, the mining of that vessel..

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Notes

1 Thomson 2005, 149
2 ibid.
3 ibid.
4 ibid.
5 ibid.
6 Kola 2003, 73
7 ibid., 74
8 Thomson 2005, 150
9 Kola 2003, 74
10 Thomson 2005, 150
11 International Court of Justice 1949 and Thomson 2005, 150
12 Thomson 2005, 151
13 International Court of Justice 1949
14 Thomson 2005, 151
15 Manning 1961, 107
16 Chesneau 1980, 42–43
17 ibid.
18 Leggett 1976
19 Campbell 1985, 270
20 Leggett 1976, 35
21 ibid., 60–61
22 ibid., 71–72
23 ibid., 72
24 Leggett 1976, 154–155

Lilia Campana INA

Shipbuilding and Naval Manuacripts from the Venetian Archives, 2007–09

Introduction

There is no Mediterranean state, republic, or kingdom of the Renaissance that did not keep detailed records of its past. Many of these survive today, having escaped the fires, sieges, and other disasters known to the Medieval and Renaissance world. Today, these documents are stored in archives and libraries across Europe, "mines of purest historical gold," in the words of the historian Fernand Braudel.[1] Shipbuilding manuscripts record technical instructions (*amaistramenti*) for building ships, and represent an invaluable source for expanding our knowledge of Medieval and Renaissance naval architecture. Written in dialect by shipwrights or by those who belonged to the Venetian maritime milieu, naval manuscripts often contain drawings, geometric diagrams, and arithmetical calculations. Given their technical content, the cryptic and unintelligible instructions contained in these manuscripts are often poorly understood, making the study of naval and shipbuilding manuscripts a challenging and fascinating task.

For the past three years, I have conducted an extensive research program in the archives of Venice in order to investigate significant aspects of Venetian maritime history and the Venetian Republic's shipbuilding practices during the sixteenth and seventeenth centuries. My research has been primarily carried out in the State Archive of Venice, in the Marciana Library, in the Correr Museum, and in other Italian archives and European libraries as well. During the summers of 2007–2009, my research concentrated on one of the most intriguing aspects in the history of Renaissance naval architecture: the *Marina Architectura* by the famous humanist Vettor Fausto (1490–1546). So far, more than eight folders (*fondi*) have been examined, and countless manuscripts have been transcribed, translated, and studied. In addition, many other documents, not specifically related to the topic of the research but relevant to sixteenth century maritime activity were brought to light: they are summarized here as well. All the documents, which have been presented in professional conferences in United States and in Europe, will be made readily accessible to the scholarly community.

The *Marina Architectura*: Vettor Fausto (1490–1546)

In the fourteenth century, Italian humanists recovered the foundations of ancient learning by the rediscovery of ancient Greek and Latin works, which lay buried in many European libraries and monasteries and had fallen into obscurity.[2] The re-birth (*rinascimento*) of the Classical tradition and the spread of classically-inspired values resulted in major cultural changes and achievements in many fields, from art and literature to philosophy and architecture.[3] The Renaissance led to a scientific revolution by promoting the application of the scientific method (*ratio*) that reached its peak with the scientist Galileo Galilei (1564–1642).[4]

In Venice, the ideas of the Renaissance had a major impact on the Doge Andrea Gritti (1455-1538), who promoted radical changes not only in the reassessment of the old political institutions (*renovatio imperii*), but also in the renewal of the urban buildings (*renovatio urbis*) and in the field of technology (*renovatio scientiae*).[5] The historical conjuncture of these changes/reforms was also crucial: the maritime power of Venice was seriously threatened by the Ottoman sultan Suleiman II in the East, and the Hapsburg/Holy Roman Emperor Charles V in the West, as well as by privateers and pirates.[6] The Republic of Venice, in order to re-establish its naval power in the Mediterranean, strongly encouraged Venetian shipwrights to submit new designs for war galleys.[7] The undisputed founder and champion of this naval program was not a skilled shipwright, but a young professor of Greek in the School of Saint Mark named Vettor Fausto (1490–1546), who in the heat of this renewal proposed a new *scientia*, the marine architecture.

In 1525, Vettor Fausto proposed to the Venetian Senate to construct a galleass, a vessel whose design he claimed was based upon the quinqueremes "used by the Romans during their wars" and that he had derived the shipbuilding proportions "from the most ancient Greek manuscripts."[8] A few months later the Senate decided to let Fausto attempt his project and assigned him a ship shed in the Arsenal. [9] In October 1526, Fausto—the famous lecturer of Thucydides, Aristophanes, and Pindar—started the construction of his galleass working side by side with shipwrights in the Arsenal.[10] Fausto's *quiqueremis* was designed as a twenty-eight bench galleass rowed "alla sensile" by five rowers on each bench on both sides.[11] The *quinqueremis* was finished in January 1529 and launched in April of the same year, amid a general skepticism which was soon dispelled by Fausto when he won a race against the light galley "Cornera". The Venetian historian Sanuto wrote an enthusiastic report on that occasion, celebrating Fausto's revival Greek science.[12]

The *marina architectura*, literally "marine architecture," consisted of geometrical shipbuilding methods that proceed from a deep knowledge of ancient mathematicians' texts. Fausto, in a letter to his friend, the humanist Giovan Battista Ramusio, claimed that his naval architecture was based on *litterae* et *disciplinae*, the "knowledge" (*disciplinae*) which comes from the study of ancient works, the "erudite letters" (*litterae*).[13] For this reason "marine architecture" does not require the mere *fabrilis peritia*, "the craftsman's practice", but rather the architecturae professio, "the science of architecture", based on a shipbuilding principle (*navium ratio*) which proceeds from the knowledge of Greek and Latin texts.[14] During this period, traditional shipbuilding construction was still based on empirical methods which relied on shipwrights' skills and years of practical experience.[15] Vettor Fausto thought that the naval architecture, just like terrestrial architecture, might similarly be improved through the imitation of the ancient architects. Besides the influence of Vitruvius's *De architectura* and Leon Battista Alberti's *De re aedificatoria* (1450) on his work, Fausto extensively studied the works of the ancients. He published a Latin translation of the Pseudo-Aristotelian *Mechanics* and applied the fifth question of the *Mechanics* (the so-called parallelogram of velocity) to the steering mechanism of the stern rudder.[16] In addition, an unpublished document from the State Archive of Venice reveals that Fausto derived aspects of his *marina architectura* from Euclid's *Elements*. Another important source for the rowing arrangements in the ship is the *Conics* by Apollonius of Perga (ca. 262 B.C.–190 B.C.).

Although the Arsenal of Venice built several galleasses "in Fausto's way," no archeological remains survived. Therefore, the primary method of investigating these vessels is archival research. Since 2007, in the State Archive of Venice, several folders (*fondi*), each containing hundreds of manuscripts, have been investigated. Each *fondo* consisted of many registers (*registri*) and sub-folders (*filze*), both containing the documents kept by the corresponding Venetian office. In order to carry out the background research on Fausto and his ingenious contribution to naval architecture, records of different government councils have been investigated: *Comuni* and Secrete *from Consiglio di Dieci Comuni* (Council of Ten), Registers and Strands from the *Senato Mar* (Senate of the Sea), *Maggior Consiglio* (Major Council), *Patroni e Provveditori all'Arsenale* (Lords and Superintends of the Arsenal), *Notarial acts* and Secrets Deliberations from the *Collegio* (College), *Senato Terra* (Senate of the Land), *Avogaria di Comun* (Investigative Magistracy).

The most revealing document is the manuscript titled *Misure di vascelli di...Proto dell'Arsenale di Venetia* ("Measurements of vessels by...a master builder of the Arsenal of Venice'"), which contains shipbuilding instructions for several types of ships. The manuscript, originally belonging to the private collection of the erudite Giovan Vincenzo Pinelli (1535–1601), has been never studied, and the author of the manuscript is still

unknown. The series of calculations in the manuscript are based on both ancient and modern mathematics, requiring an extensive knowledge of mathematics that only Fausto could have possessed. The hypothesis advanced is that the manuscript is the work of Fausto's pupil, Giovanni di Maria di Zanetto nicknamed Zulle, who became *proto* (master shipbuilder) of the Arsenal in 1570. Zulle copied the shipbuilding instructions of his master, and, at the eve of the battle of Lepanto, he built the last galleon *alla Faustina* ("in the Fausto way"), which became the flag ship of the Christian fleet led by Marcantonio Colonna against the Turks.[17] However, the "Greek dream" of Fausto and his *marina architectura* sank off the coast of Ragusa, when the galleon was struck by lightning and completely wrecked.[18]

Geometrical Methods in Venetian Ship Design

Another significant part of my research involves the study of the geometrical methods used in ship design in the Arsenal of Venice from the fourteenth to the seventeenth century. In the Late Middle Ages, shipbuilding was mostly an empirical practice depending on the shipwrights' skill, which developed from acquired experience communicated orally from masters to apprentices, and fathers to sons. However, during this period practical shipbuilding knowledge began to be recorded in texts, and no longer limited to the tradition of oral transmission. Literary evidence suggests that, at least starting from the 14th century, shipwrights used a number of geometrical methods to ensure control over the final shape of a ship's hull with a fair degree of precision. Although it is assumed that shipwrights were generally uneducated craftsmen, the geometrical methods used in ship design involved a profound understanding of complex mathematical notions, such as algorithms and triangular numbers. Geometrical methods used by shipwrights in ship design are documented in several 14th- and 17th- century manuscripts and naval treatises, including the *Libro di navigar* ("The Seafaring Book"), preserved in the Angelo Mai Library in Bergamo (Italy) and dated to the second half of the 14th century, and the *Libro di appunti di Zorzi trombetta da Modon* ("The Notebook of Zorzi trombetta from Modon"), kept in the British Library in London and dated to 1444–1449. These are the earliest documents yet known recording geometrical methods used in ship design. Four methods are described in these manuscripts: the *chugno* or *schagion* (the so-called "incremental triangle"), which is based on the triangular numbers by Pythagoras and was mathematically explained by Gauss (eighteenth century) who codified the numeric progression by his algorithm (already known by Fausto); the *meza luna* (the so-called "half-moon"), which derived from methods used by Arab astronomers to calculate the sine and the cosine; the *brusca* ("infinite gauge"), which is also based on triangular numbers; and the *tolela*, or "full-moon", whose study is in progress and might have been used for the design of the ship's futtocks. Later on, two more geometrical methods came into use: the *scueto* and the *pavion*. These are documented in 17th-century naval treatises, such as the *Architettura Navale* (1686) by Stefano de Zuanne (British Library) and the manuscript SH133 (1691) from the archive of Marseille written by an anonymous author at the end of the seventeenth century. This research was primarily carried in Italy and in London and it is still in progress.

"A Horrible and Dreadful Shipwreck." The Fateful Voyage of the Venetian Merchant Piero Quirino (1431)

As a premise, this research started in 2007 as a term paper for the class "Outfitting and Sailing the Wooden Ship," which was taught by Dr. Kevin Crisman. The paper focused on a voyage account, whose original manuscript came to light last year in the Marciana Library of Venice. This manuscript tells about the Venetian merchant Piero Quirino, who, on April 1431, departed from Candia on board his *chocha*, a square-rigged round ship, for the Flanders trade. After sailing past the Strait of Gibraltar, Quirino encountered strong winds and ocean currents, which threw his ship off course, causing it to become wrecked at Sørland (Lofoten Archipelago, Norway). Miraculously, Piero Quirino and ten other survivors were rescued by fishermen who brought them to the nearby island of Røst, where the survivors lived for some months. Quirino recorded a detailed description of his shipwreck, providing extremely detailed information about his ship, rigging equipments, maneuvers, sailing routes, trade, and cargo.

Perseverance in archival research can often be extremely rewarding. The most exciting discovery of the 2009 research season has been eight unpublished documents from the State Archive of Venice. They are the legal contracts that Piero Quirino made in order to create a partnership, to charter his merchant vessel, and to buy his cargo. They represent a unique case because they describe in detail all the legal *iter* Piero Quirino went through for his enterprise. Moreover, while there is much information about the State commerce, very little is known about the private trade during the 15th century. These documents, which have been written in Latin with some Venetian and Greek influence, have been recently presented in a

symposium held by the Society for the Medieval Mediterranean and will be soon available to the scholarly community.

A Case of Espionage in the Arsenal of Venice in 1621

Finally, an intriguing folder containing a case of espionage in the Venetian Arsenal during the 17th century surfaced in the season 2008. On August 21, 1621, the State Inquisitors of Venice tried three master builders and one shipwright of the Arsenal who were suspected to have sent to King Philip IV a technical drawing for the construction of a *galea grossa* (great galley). With the complicity of the Spanish ambassadors in Venice and Genoa, the ship's lines drawings were sent to Philip IV via Genoa. The four suspects also delivered to the King a wooden model of the great galley, and proposed to build for him ten great galleys in the Genoese shipyards, whose "measurements would perfectly fit the line drawings and the model." The intriguing aspect of international espionage aside, this document is of great significance for the history of Venetian naval engineering, because it represents the earliest unequivocal mention of a ship's line drawing. The research focus on technical drawings recorded in Venetian shipbuilding manuscripts and treatises from the fourteenth to the seventeenth centuries, and their practical applications to naval engineering in general. It also explores the relationship between the ship design and the practical construction, the problem of the transmission and circulation of practical knowledge. The entire folder with its unpublished documents will be presented in the Renaissance Annual Meeting (Venice, 8–10 April 2010) at the History Department of Ca' Foscari University.

Acknowledgements

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Notes

1 Braudel 1972, 1:18.

2 Weiss 1969 and 1977; Reynolds and Wilson 1975.

3 Ergang 1967; Wilson 1992, 124–57.

4 Shapin 1996; Butterfield 1962.

5 Tafuri 1984 and 1985; Concina 1988 and 1989; Valeri 1958.

6 Benzoni and Menniti 1991, 4:167–98; Paruta 1718, 1:301 and 528; Cessi 1988, 2:526–28.

7 Lane 1973, 367–69; Concina 1990, 117–38.

8 Archivio di Stato Venezia (henceforth ASV), Consiglio di Dieci, Secreta, filza 1. See also: Concina 1990, 55; Hocker and McManamon 2006, 16–18; Bash 1998, 34. For the Roman *quinqueremis*, see Morrison and Coates 1986, 2, 9, 11, 23, 157; 1996, 57–66, 294–6, 355–61; Casson 1971, 101–2, 105–6, 113–37, 140–44; 1994, 79–95; Shaw 1995, 163–71; Morrison 1995, 68–9.

9 ASV, Consiglio di Dieci, Secreta, reg. 1, fol. 62r.

10 Writing a letter to his friend Ramusio, Fausto compared the hard-working days in the Arsenal to Heracles's descent into Ade and to Aeneas's one into Avernus. In Weber 1894, 128–133.

11 For a description of Fausto's *quinqueremis*, see Jal 1840, 1:377–84; 1848, 1248; Fincati 1881, 57; Casoni 1838, 17; Concina 1990, 82; Lane 1992, 59–65.

12 Sanuto, L, col. 347.

13 Weber 1894, 128–133.

14 Supra n. 14.

15 Chiggiato 1987.

16 Venice, Marciana National Library, Aristotelis Mechanica Victoris Fausti industria in pristinum habitum restituta ac latinitate donata, in aedibus Iodoci Badii (1517).

17 Concina 1990, 115; Hocker and McManamon 2006, 17.

18 This information comes from the recently discovered manuscript titled Il Chartiggiatore (1570) under examination by the author.

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RPM Nautical Foundation
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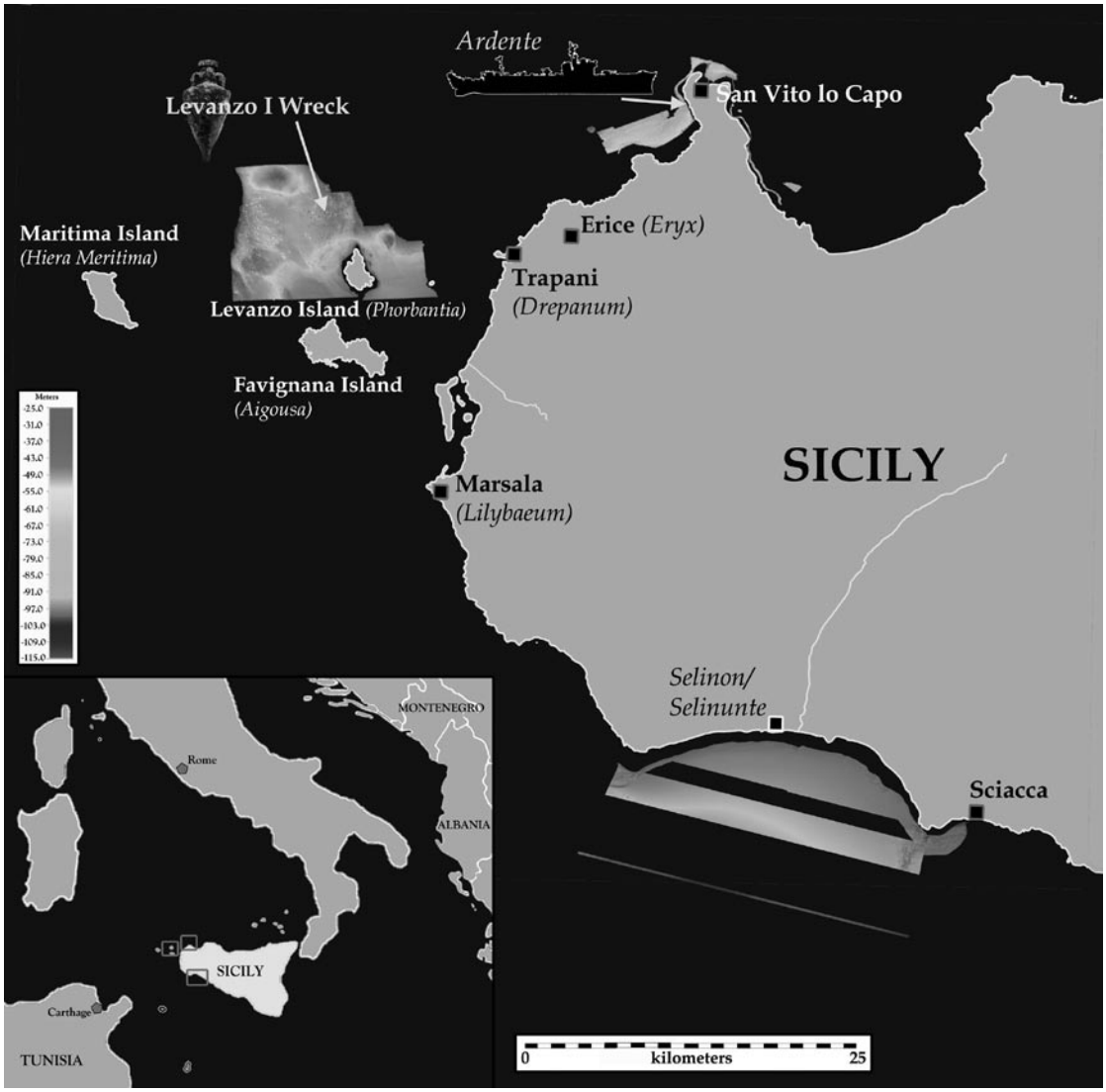
2009 Expeditions in Sicily



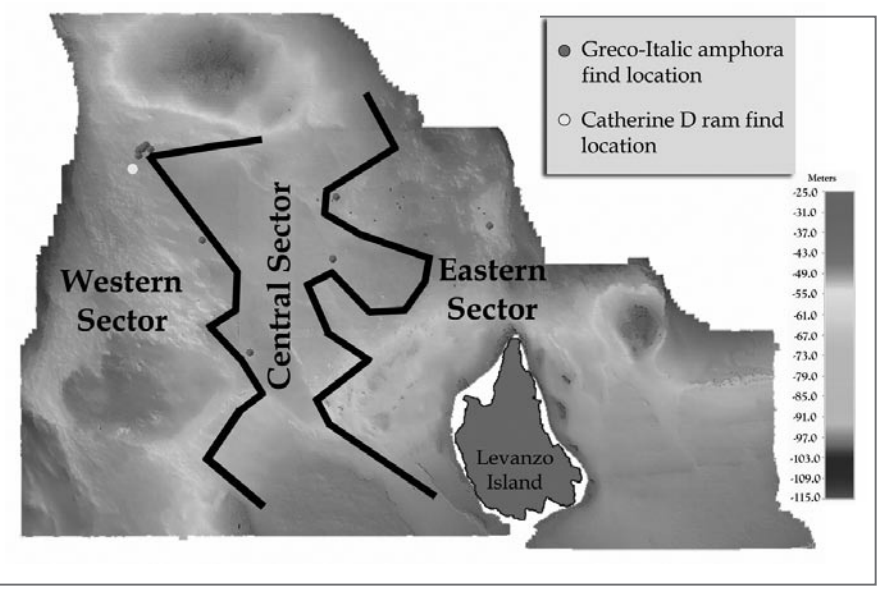


FIG 1 previous page
Multibeam survey coverage in the three Sicilian project areas. Map by J. Royal, RPMNF.

FIG 2 right
The Egadi Islands survey area demarcating seafloor topography sectors and *find* locations for Greco-Italic amphoras and the Catherine D ram. Map by J. Royal, RPMNF.

Since 2005, RPM Nautical Foundation (RPMNF) and the Superintendent's Office of Underwater Archaeology in Sicily (Ufficio di Soprintendenza del Mare) have conducted a survey of coastal waters off the NW Sicilian coast. Over these past years, several areas have undergone intensive multibeam survey with ROV verification of anomalies (Figure 1). Efforts around the island of Levanzo, one of the Egadi Islands NW off of Trapani, have continued from 2005. In 2009, a project ventured into the southern coast, in the bay of Selinunte, to ascertain the efficacy of work in this region. A small survey was also conducted around Capo San Vito in 2007 and verification took place in 2009.

Egadi Islands

With a large amount of multibeam coverage completed from 2005–08, no additional multibeam survey was conducted during the 2009 season. A result of completing a considerable coverage area is a large number of anomalies that require verification. Although the number of anomalies is re-adjusted as new criteria and reviews are made, the number of unverified anomalies remains substantial. Based on experience and an evolving knowledge of the area's seafloor topography, two strategies have developed for ROV operations. The majority of the survey area's western sector (Figure 2) features closely-spaced, low, and relatively small rock outcrops that observations have shown to ensnare drag nets. As such, this area is largely undisturbed by fishing nets except on its periphery where material is dumped when nets are snagged. The densely-packed anomalies and protection from drag nets often require area searches in the western sector. A rather clear and abrupt demarcation exists between the rocky western sector and the sandy seafloor of the central sector. As the central sector is largely devoid of rock outcrops, drag nets have flattened the sand cover and little biological or cultural material survives. All that is left is a barren, flat landscape; the only features are long drag marks that criss-cross the seafloor and an occasional flat rock outcrop protruding from the sand. Any cultural material deposited here in antiquity has been recovered by fishing nets and/or moved to rocky areas and dumped. The survey area's eastern sector is a patchwork of rock outcrops and open sandy stretches; hence, dragging has impacted to some degree this area as well. Although the few anomalies explored in the central sector indicate little probability of surviving material, the western and eastern sectors hold potential. The Levanzo I wreck, discussed below, is located in the eastern sector.

During the anomaly verification and area searches, random ceramic finds were located in the western and eastern sectors. A Roman-era commonware bowl and the upper portion of a Dressel 14 amphora were discovered in the eastern sector. Numerous random finds since 2006 have been found throughout this sector, the vast majority from the Roman era. Other finds noted but not recovered during operations in 2006-8 included the upper portions of Greco-Italic amphoras. Most of these amphoras were located on the edges of survey area's central sector lying near rock outcrops (Figure 2); in a few instances the remains of snagged fishing nets were nearby. During the 2009 field season an intact Greco-Italic amphora was located here as well, and the decision was made to collect examples for analysis. Each of the amphora's collected at the edge of the western sector were of the same type,—Greco-Italic—and possessed comparable dimensions and an asymmetry of their handles (Figure 3). This may indicate that these amphoras were produced at or near the same workshop, and at certainly a common time period. Once the locations of these amphoras from all seasons were plotted, there was a noticeable concentration in the NW section of the survey area where the rocky western section begins. Interestingly this is just slightly north of the Catherine D ram find location. The most likely

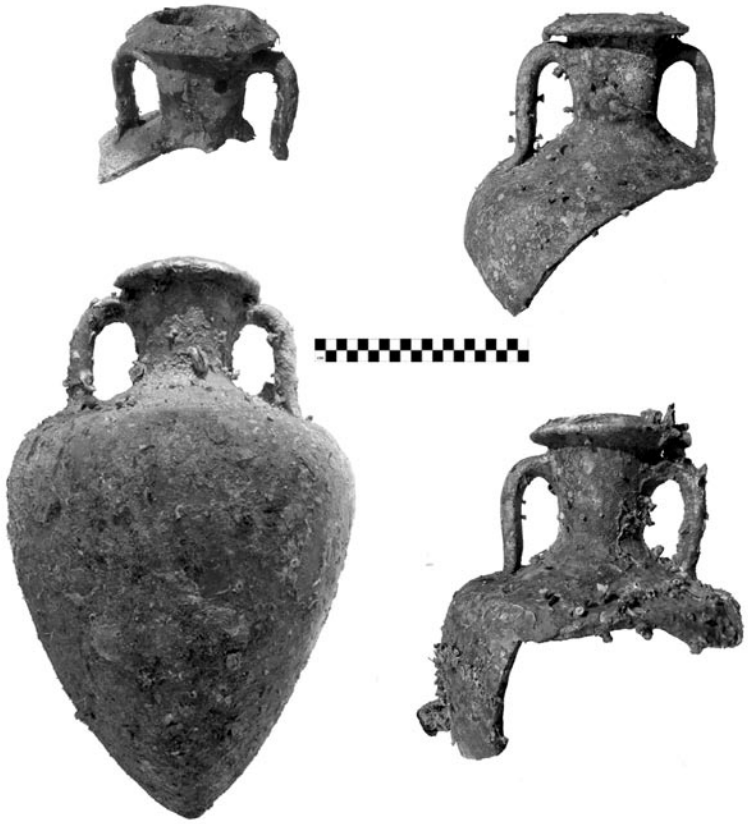


FIG 3 right
Greco-Italic amphoras retrieved during the 2009 field season. Photographs by J. Royal, RPMNF

FIG 4 below
View of Levanzo I wreck site during sonar imaging, note the flatness of the site and a temporary datum. Photograph courtesy RPMNF.

scenario for these amphora finds is that they were dragged from somewhere in the flat central sector and deposited when the fishing nets snagged on rocks. Given the great similarity of the damaged amphoras, they likely originated from a single wreck site that settled in the central sector during the 4th-century BCE. Unfortunately, the site has been razed by nets and there may be nothing left of the site. Unlike near shore environments, the shallow sediments of deeper off-shore waters do not afford wreck sites the same protection; this is shown empirically in the Levanzo I wreck site investigation discussed below.

One of the anomalies in the eastern section of the survey area was a relatively modern wreck site (Sulfur Wreck, SI09-AA). This site lies in c. 50 m of water and it was therefore possible to deploy divers as well as the ROV on the site. The primary visible remains of this wreck is a cargo of raw sulfur ore that forms a low, flat deposit. All of the sulfur cargo was fist- to head-sized chunks; many were rough hewn but others appear to have regular edges associated with their being quarried. Generally the deposit was 1–2 layers thick. One sample chunk was raised and a sample was taken for analysis by the Superintendant's Office. Some wood, possibly ceiling planks, was visible just beneath the shallow covering of sulfur ore as were several unidentified iron objects. The condition of the wood and the degree of encrustation, as well as form of the iron objects indicate a relatively modern date for the site. Based on the flat and relatively shallow nature of the surviving wreck site, it has likely been scrapped by fishing nets.

Levanzo I Wreck site SI06-AA

In addition to anomaly investigation, efforts were undertaken to further investigate the Levanzo I wreck site. This site, discovered during 2006 at the edge of the survey area's eastern sector, c. 6 km N of Levanzo Island (Figure 1), was a 4th-century AD

Roman merchantman laden with food stuffs and construction materials enroute from N Africa to the Italian mainland when it met its demise. At the time of discovery, little was known about the nature of deeper-water sites compared to that known about sites near shore. At a depth of 90 m and out of practical diver depth, it would seem such a site was safe from human exploitation and/or damage, particularly to the illegal collecting by recreational divers that plagues shallow-water sites. Initial investigation of the site documented the damaged artifacts dispersed around the surface of this relatively flat site; it remained unclear as to how far the material extended into the sandy bottom (Figure 4).

The wreck was mapped with various video/still camera combinations over the subsequent years. Additionally, a small number of artifacts were collected during the 2006 season in order to provenience the site, but no additional artifacts were collected until the 2009 season. During anomaly verification in the first two seasons, it became apparent that many parts of the survey area had been severely impacted by drag-net fisherman as discussed previously. By the beginning of the 2009 field season, it became clear that the Levanzo I site had likely suffered drag-net hits as well, which resulted in the scattered artifacts on the surface of a very slight mound. Considering the situation, Co-Director of the Project Dr. Sebastiano Tusa, Superintendent of Underwater Archaeology for Sicily, agreed the site required mitigation and arranged conservation support for artifact retrieval. Comparatively little is still known about the nature of the deep-water sites; however, with such projects as these, more is being discovered about these sites and the threats to them. Between discovery and the 2009 field season appropriate equipment, software, and methodologies were developed in order to properly map and test excavate the site to archaeological standards. The Levanzo I site's particular characteristics also make it ideal for testing such equipment and methodologies that can later be applied to other sites.

Although largely disturbed, every effort was made to control and record the provenience of artifacts thorough various methods of site mapping. A primary stratagem was the control of artifacts' x and y coordinates because of the site's greater scale and that the site is primarily surface finds. The initial step was to place pvc pipe and cement datums of 1 m in height around the site in order to provide reference points for measuring. These datums were integral in mapping artifacts and positioning imagery within Site Recorder software. Two methods were used for measuring the datums' positions on the site: absolute and inter-datum measurements. Absolute positions were obtained by placing a beacon fitted with a hook on each of the datums with the ROV. The beacon positions were recorded on *Hercules* and displayed upon the surface model of the seafloor with IVS Fledermaus software. Once the positions were plotted on the seafloor model in Fledermaus, the depths at those positions could be ascertained from the bathymetric data. These beacon positions also provided real-world location and orientation for the wreck site.

Inter-datum measurements facilitated by a high-frequency sonar fitted to the ROV were also used to ascertain datum positions. This sonar clearly images the datums and small objects within a 180º sweep that covers the entire site as it is relatively flat. In the sonar's software, sweep images are recorded and precision measurements are possible between or along any visible object. In order to increase the accuracy of measurements, the ROV was placed in three different vantage points around the site. Additional recordings and measurements were made during subsequent positioning for measuring temporary datums, or at any time the ROV was at rest on the periphery of the site. With each datum identified in the various sonar recordings, between 5 and 10 measurements were made between any two datums. Statistical outliers of measurement values were ignored and the remaining cluster of measurements was averaged; this inter-datum distance value was used in Site Recorder. Both the inter-datum and beacon positions were interpolated in Site Recorder, and along with bathymetric depth data provided a good representation of the datum positions (Figure 5).

With the datum positions plotted on the seafloor model in Fledermaus, it was possible to ascertain the site's height profile. A 30-m transect was taken on the surface map across the SE portion of the site, between datums D1 and D6, at a right angle to the site's long axis (Figure 6). Over this 30-m distance, the highest point on the site rises less than 30 cm, some of which is likely due to the rock outcrops that lie beneath the surface and are exposed around the site.[1] These rock outcrops rise to c. 35–40 cm off the seafloor around the site, and are undoubtedly the direct reason for any part of the wreck surviving as they deflected drag nets slightly over the site. However, any of the material above the height of the rocks when the shipwreck first settled here was now gone. The result is a flat, shallow site ideal for a trial of mapping and excavation methodologies.

Further recording of the site included video with a downward facing camera in order to document the site with datums in place and produce a photo mosaic. The ROV remained 4–5 m over the site to obtain good contextualized images. For the mosaic, the wider-scale images from 2009 were used to formulate the general image of the site area; afterwards, the more detailed still photograph images of artifact groupings obtained in 2006 and 2008 were overlain. The mosaic was then imported into Site Surveyor and aligned according to the matching of datum positions. A combination of recording methods were now available to ascertain the locations of surface artifacts, and allowed the measurement of the features and objects in the mosaic.[2] With the mapping and provenience under control for the site, it was

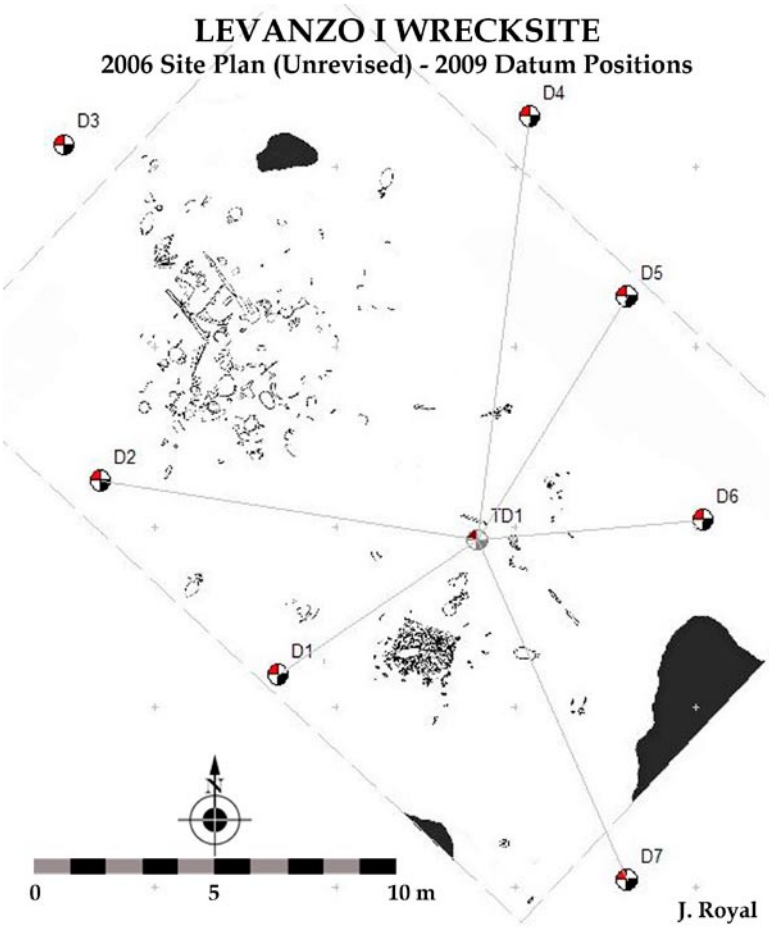
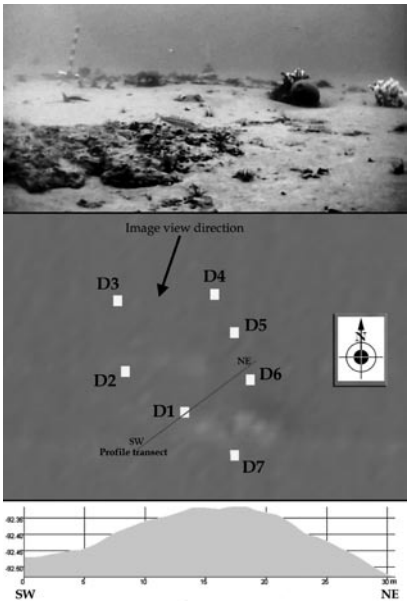


FIG 5 left
Image of data placed in 3-H Consulting's Site Surveyor 4 software showing the 2009 datum positions around the Levanzo I wreck site; the site plan is one produced in 2006. Plan by J. Royal, RPMNF.

FIG 6 below
ROV view of the Levanzo I site while sitting on bottom, between datums 3 and 4; Center: datum positions in IVS Fledermaus software and transect position over site; Bottom: profile of transect showing cross-section of seafloor. Graphic by J. Royal, RPMNF.



possible to proceed with the collection of surface artifacts for analysis; the majority of which were intact or fragmentary amphoras (Figure 7).

As a final experiment in the ongoing assessment of the Levanzo I wreck site, two small test excavations were conducted. Excavation was limited to two 1-m squares at the center of the site where it was largely free of surface artifacts. A form constructed from flat aluminum and painted red/white in 25-cm increments, and bolts attached through the corners to resist shifting after placement (Figure 8). Based on the method commonly utilized when recording sites in dive operations, the square was segmented into four 50-cm^2 quadrants, A–D, and each quadrant further subdivided into four 25-cm^2 sub-quadrants, designated 1–4. Hence, during excavation the notations made record artifact positions based on this quadrant system. Once placed on the seafloor, a video flyover recorded its relative position. Additionally, temporary datums were placed on two opposing corners and their positions were recorded with the sonar and measured in relation to the seven datums; the position of the square was then interpolated in Site Surveyor.

A water dredge on the ROV performed the excavation duties (Figure 9), with all dredged material run through a mesh bag that was examined on deck. The dredge featured a collar specially designed to shoot short bursts of water from six 2-mm holes in order to break up or move sediment for easier dredge operations, akin to hand-fanning. However, the jets were not required in the upper layer of easily-removed loose sand. The jet collar was necessary in order to remove the underlying dense mud layer excavated to a limited degree in order to test for the presence of artifacts, which

included a 15-cm deep sondage in one quadrant. Depths of sediment layers and artifacts were ascertained with scales held in the ROV manipulator arm or by those affixed to the dredge. When artifacts were encountered in the square, and noted in the log, they were removed with the manipulators, or more often through the suction of the dredge, to a small basket next to the excavation square. A description of individual finds from the excavation, along with their analysis and implications, will be detailed in an upcoming publication.

Video recording provided a second, and important, record of all excavation. With real-time video of excavation it is possible to recreate and review all work performed, as well as creating a permanent record of the event. As such, the provenience of artifacts within a square can be determined and rechecked if necessary, and any assessment of sediment in relation to the artifacts is also reviewable. This recording utilized three separate cameras: a down cam, a pilot cam, and a manipulator cam; thus, it was possible to obtain a plan view, a forward perspective view, and close-ups of the work performed. Furthermore, video was facilitated by two powerful lamps attached to the ROV's deployment cage (TMS) and pointed downward. With the TMS positioned above the excavation square, a much improved image was attained with truer colors and much less particulate visible in the water column.

Based on excavation in both squares the upper sediment layer on the site is a medium-grained, light-color sand 5–7 cm thick that was mixed with shells and small rock fragments. Below this layer is a harder packed mud layer slightly darker in color. This underlying layer density required mechanical break-up in most cases to dredge. All artifacts were found either on the surface or in the loose upper sand layer; the 15-cm deep sondage extended approximately 10 cm into the dense layer with no artifacts encountered.

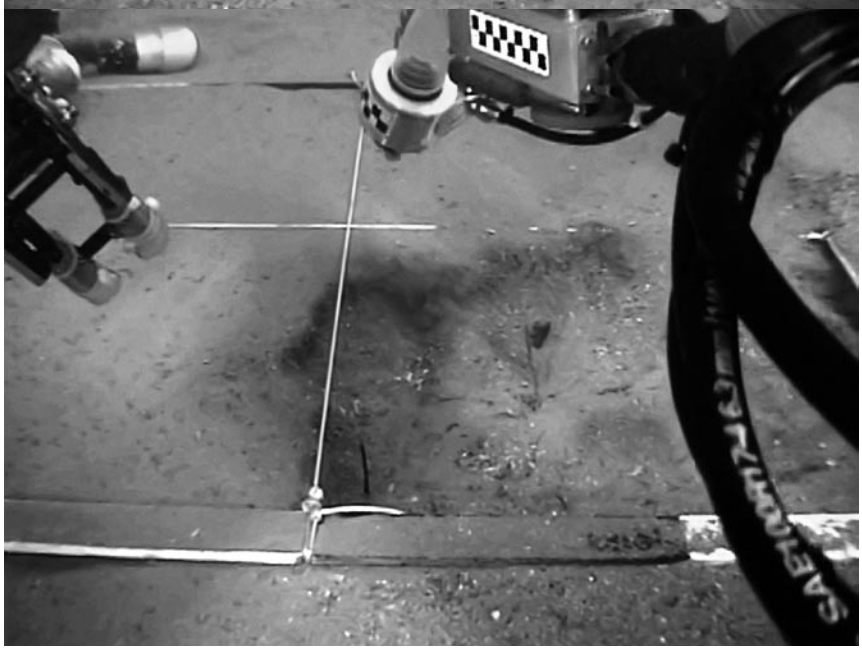


Fig 7 top
Retrieval of surface artifacts with ROV. Photograph courtesy RPMNF.

Fig 8 above
Excavation on the Levanzo I site utilizing the metal square and the ROV's water dredge. Photograph courtesy RPMNF.

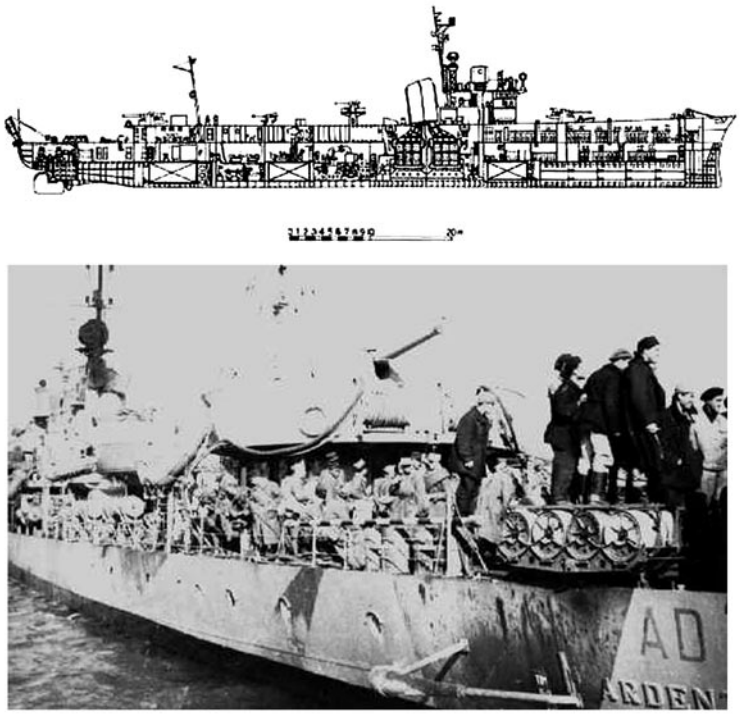


Fig 9
Cross-section of Italian Cyclone class ship and image of Ardente with crew. Images courtesy S. Zangara, Ufficio di Soprintendenza del Mare, Sicilia.

As the test squares were in the central portion of the site that is largely devoid of ceramic concentrations, the sandy upper layer is slightly thicker on the NW and SE portions of the site. The depth reached 10–15 cm where a slightly buried amphora was removed on the SE end of the site.

This shallow sand cover on the site provides virtually no protection to the artifacts from further drag net incursions. Consequently, the ceramics exposed on the seafloor upon discovery were almost all that remained of the cargo due to the devastation of the drag nets. This reaffirmed the necessity for mitigation for this site, and illustrates the peril that offshore sites face. The Levanzo I wreck is similar to many others in deeper waters, where sedimentation rates are lower than those at the shore and can leave wreck sites largely exposed. In fact, this may be the norm rather than the exception for sites further offshore. The particular threat of drag nets is amplified as they dig into the sandy surface layer, and given the lack of sand cover for offshore sites, the damage they do is catastrophic. Unfortunately it is probably too late for an untold number of wrecks throughout the Mediterranean.

South Sicilian Coast

The opening mission for the 2009 field season brought the RPMNF research vessel *Hercules* and crew to the SW coast of Sicily (Figure 1). This ambitious project entailed a survey of the SW coast with the goal of moving eastward; however, one also undertakes the task of assessment during the initial season in any previously unexplored area. For 2009, the survey centered in the elongated bay of Selinunte that spans between Capo Granitola to the west and Capo San Marco to the east; just east of Capo San Marco is the port town of Sciacca out of which the team operated. The bay is named for the ancient town of Selinunte, Greek Selinon, that is now a 1740-km^2 archaeological park. As one of the most important Greek cities in Sicily, Selinunte thrived during the 6th–5th centuries BCE when numerous temples were constructed on and around its acropolis situated between the two small rivers Cottone and Modione. The city was founded in 7th Century BCE by colonists from Megara Hyblaea, a town located near Syracuse to the SE, and was largely destroyed in 409 BCE by the Carthaginians. In c. 250 BCE, during First Punic War, the Carthaginians abandoned the city, destroyed most of it, and consolidated in Lilybaeum to the west. Major damage to the temples was probably a result of an earthquake in the Byzantine era.

In addition to the Cottone and Modione rivers, the mouth of the 77-km long Belice River located 4 km E of Selinunte empties into the bay; recently this river is seasonally active due to agricultural demands. Geologic investigation around Selinunte and the bay indicate a complex and active past due to the numerous faults running through the area. This section of coast

has experienced subsistence and uplift, and the bay is filled with sediments from the last marine ingression that followed the latest glacial era.[3] Adding to this sedimentation are the outflows of the Belice, Cottone, and Modione rivers.

Although three productive weeks were completed, results of the survey are limited to an assessment for further work. Analysis of multibeam data produced few anomalies and showed a largely featureless seafloor. Limited ROV verification operations were attempted, and together with a small number of dives on shallow targets, problems with this area for survey were confirmed. The rivers empting into the sea have created a sand build-up near shore that may preclude the detection of ancient-medieval shipwrecks. Divers reported a modern sailboat sitting upright on the seafloor and buried to its sheerwale in soft sediment. Hence, it is likely that ancient-medieval material is buried within the bay and will have to await storm action for the opportunity to detect. Survey moved further out from the bay and a few test lanes were run at the outermost edge. ROV prospection beyond diver depth noted this sediment cover likely decreases with distance from shore; however, there was evidence of drag net incursions on the seafloor. Assessment indicates the area mirrors that of the central portion of the Egadi Islands Survey area; in such areas were drag nets have been frequently used, further work will have little use. This finding was somewhat unexpected as the chart of the area provides a caution in or near the bay for ships not to anchor, dredge, trawl, lay cables, etc. due to obstructions and unexploded ordnance.

A strategic plan for future work would include monitoring the bay for the impact of large storms that could remove sand cover, even temporarily. Other areas on the southern coast should be assessed as well, particularly those reported to have enjoyed protection because of pipeline, fishery, etc. in the zone. Likewise, areas that have significant rock outcrops that would also deter drag net operations. Prospection with the ROV between the 50- and 120-meter contours to assess for the amount of sand accumulation and geologic features may be an efficient first step on the southern Sicilian coast. The early 5th-century BCE Gela shipwreck discovery, over 800 m from shore at c. 5 m of depth, highlights the importance of this stretch of coast, particularly given the presence of ancient Greek cities such as Selinute, Agrigento, Gela, and Syracusa. Heavy sediment cover helped preserve the Gela wreck, yet also compounds the detection of such wrecks. Corinthian trade was heavy in Sicily, however, as with Albania and Montenegro little is known of the offshore waters on this portion of the Sicilian coast and what sites are present to address such research questions.

San Vito Lo Capo

In the course of the 2007 field season, multibeam survey was conducted around Capo San Vito at the request of the Superintendent's Office of Underwater Archaeology to the search for a WWII-era British submarine Thunderbolt reportedly lost in the vicinity (Figure 1). As the area was promising on several levels, the survey circumscribed the cape. The multibeam data was examined for the presence of the submarine alone; a promising anomaly was located and its location transmitted to the Superintendent's Office of Underwater Archaeology at the end of the 2007season. The most promising anomaly was comprised of two large sections near one another, the larger over 50 m in length. A brief attempt to verify the anomaly was halted that season due to equipment problems, and the ram discovery of the following season precluded a return. Special efforts were made during the 2009 field season to verify this anomaly that was clearly the remains of a large, modern vessel.

In August, the team moved from Levanzo to the site's position and the ROV was deployed. Video of the site clearly indicated there were two large sections of a single WWII-era naval vessel present, separated by approximately 75 meters. Upon viewing the superstructure it was clear the vessel was not a submarine, but a type of torpedo ship. As in other areas investigated, fishing nets were tangled in the wreckage. Observations and notes were taken by Dr. James Delgado of INA and Stefano Zangara of the Superintendent's Office of Underwater Archaeology. Dr. Delgado's experience with WWII-era vessels assisted in the initial identification of vessel type, as well as noting the massive damage the vessel incurred. Subsequently, Mr. Zangara's research[4] provided an identification for the vessel: *Ardente*, a cyclone-class torpedo ship in the Italian navy (Figure 10). Deployed in 1942, the 910-ton *Ardente* was one of 16 vessels of this class with a length of 87 m, a 9.9-m beam, and a draft of 3.7 m. These torpedo boats were armed with anti-aircraft guns, depth charge throwers, and four torpedo tubes. *Ardente* sank the submarine HMS *P48* in December of 1942, and shortly thereafter on January 12, 1943, official reports indicate it struck the Italian destroyer *Grecale* while in convoy. However, the location for *Ardente's* sinking was reported near Punta Barone, on the island of Salina, one of the Aeolian Islands, on the NE coast of Sicily. The work by the Superintendent's office has clarified this chapter in Italian naval history.

Even with the rather narrow band of depth contours for which the multibeam system can effectively survey, the amount of sediment coverage is minimal compared to the southern coast. Sediments from the high peaks near shore along the N coast are undoubtedly settling slightly further

offshore at depths over 300 m. Whereas the 100-m contour is often over 25 km offshore off the southern coast, it is not uncommon to reach depths of 300–800 m, 5 km off the northern coast. As such, the 2010 survey plan will focus new multibeam survey from Capo San Vito towards Cap Gallo at Palermo, and eventually to Capo Zafferano at the eastern point that forms the Bay of Palermo.

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Notes

1 The exposed rock outcrops were not included in the transect. A slight amount of sand has certainly built up around the artifacts, but their scant presence due to drag net incursions would not provide significant sediment traps.

2 Some of the larger artifact and natural features of the site were discernable in the sonar data, and were measured in relation to datum positions and one another as a check on the overlay positions generated in Site Recorder. Although gross measures, they did confirm the efficacy of integrating the mosaic and datum measurements.

3 Piro, S., and L. Versino 1995.

4 Zangara, S. 2009.

Bradley A. Krueger
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Great Lakes Steamboat Archaeology:

The Anthony Wayne Shipwreck Survey 2009 Report

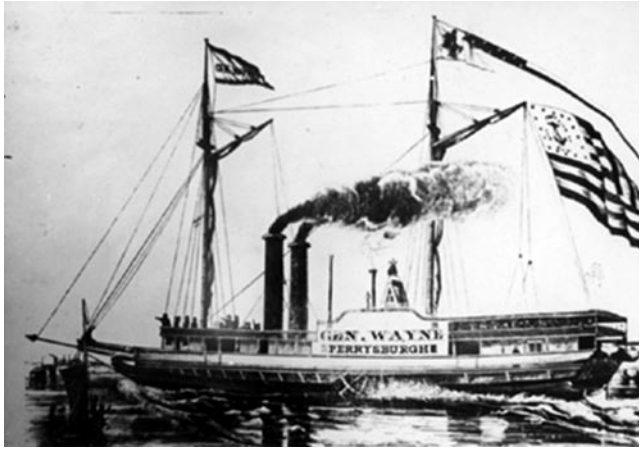


FIG 1
The only known contemporary image of *Anthony Wayne*, from an 1838 lithograph. Courtesy of the Clarence S. Metcalf Great Lakes Maritime Research Library of the Great Lakes Historical Society, Vermilion, OH.

Introduction

The cold waters of the Great Lakes hold a great many secrets. On the bottom of Lake Erie, six miles north of Vermilion, Ohio, the remains of *Anthony Wayne* rest quietly. This side-wheel passenger and cargo steamer met its end in the spring of 1850 as the result of a devastating boiler explosion. Fate decreed that the steamer's afterlife should be spent entombed within the spongy lake bottom, lost from the people who built, manned, and sailed aboard this once opulent steamboat. In the fall of 2006, remote sensing technology was successful in penetrating the watery nether to locate the remnants of this steam-powered leviathan. At last, after being lost for over 150 years, the steamboat *Anthony Wayne* had been discovered, making it one of the earliest archaeological examples of a steamboat in all the Great Lakes.

In 2007, the Great Lakes Historical Society partnered with Texas A&M University and the Cleveland Underwater Explorers (CLUE) to record the remains of *Anthony Wayne.* After a very successful preliminary season in 2008 in which the site was mapped and the wreck recorded, it was decided that much could be achieved by excavating key locations on the site. Upon learning of this project and its significance to the maritime history of the Great Lakes, the Institute of Nautical Archaeology offered to lend its support to the project so that fieldwork could resume in the

summer of 2009. The *Anthony Wayne* Shipwreck Survey is striving to fill the gaps left by history and gain a better understanding of how steamboats were built, outfitted, and utilized on the waters of the Inland Seas.

Vessel History

Anthony Wayne was built by shipwright Samuel Hubbell in Perrysburg, Ohio, in 1837 (Figure 1). Helmed by veteran lake captain Amos Pratt, the newly built *Anthony Wayne* measured 156 feet 6 inches in length, 25 feet 9 inches in beam, 10 feet 10 inches in depth of hold, and was registered with a 390 ton capacity. Designed as a passenger carrier for the route along the southern Lake Erie shore, the steamer could accommodate over 200 travelers and was outfitted with 20 lavish staterooms, gentlemen's and ladies' cabins on the boiler deck, and steerage quarters. In addition to passengers, *Anthony Wayne* was capable of carrying the equivalent of approximately 1,500 barrels of packet freight below decks. Laden with passengers and freight, *Anthony Wayne* made routine runs between Toledo, Ohio, and Buffalo, New York, with stops at several ports along the way.

The steamer was initially owned and managed by the Perrysburgh & Miami Steamship Company, a group of local entrepreneurs involved in Lake Erie shipping. The following year, in 1838, Perrysburgh & Miami joined forces with other transportation companies from around Lake Erie to form the Western Transportation Company. Under this ensign, the *Anthony Wayne* ran regular transportation service from Toledo to Buffalo, opposite the Commodore Perry, and occasionally made trips to the other Upper Lakes, calling at Milwaukee and Chicago. *Anthony Wayne* enjoyed a relatively quiet and successful career for the next several years, but time ultimately took its toll. In 1847, it was discovered that *Anthony Wayne* was too decrepit to continue on as a steamboat, so the owners decided to convert the old boat into a sailing barge. With all of its machinery and internal apparatuses removed, *Anthony Wayne* was then purchased by Charles B. Howard & Company of Detroit, Michigan, with plans to completely rebuild the steamer. *Anthony Wayne* was towed up through the Detroit River to the shipyards at Trenton, Michigan, where the hull was improved with alterations to its dimensions and cargo capacity, and new cabins and superstructure were created. *Anthony Wayne's* old engine went to the newly built steamboat *Baltimore*, and was replaced with a high-pressure, direct-acting horizontal engine from the steamer Columbus. Under the ownership of Charles Howard and his business partner, Captain E. C. Gore, the refurbished steamboat spent the remainder of its days plying the waters of Lake Erie on the Detroit-Toledo-Buffalo shipping line.

FIG 2
Map showing the location of *Anthony Wayne*. Google Images.

Loss of *Wayne*

On Saturday, 27 April 1850, *Anthony Wayne* started out on its usual run from Toledo to Buffalo with a complement of 30 crew members, with scheduled stops at various ports along the way. The steamer departed Toledo around 9:00 am with 25 to 30 passengers and came into Sandusky in the afternoon. Here, the *Anthony Wayne* picked up 30 to 40 more passengers, most of whom had arrived in town that afternoon by rail, and was also laden with a cargo of local wine and spirits, livestock, seeds, and other packet freight. The steamer left Sandusky for Cleveland at 10:00 pm Saturday evening, due to arrive early Sunday morning.

Between midnight and 12:30 am on 28 April 1850, while *Anthony Wayne* was 6 miles north of Vermilion, Ohio, disaster befell the steamer. The vessel's two starboard boilers suddenly exploded, despite having been inspected by the engineer on watch both 10 and 5 minutes before the accident. The blast instantly destroyed the engine room and badly damaged the superstructure. The cargo of wine and spirits quickly ignited and fire spread rapidly through the vessel. After people recovered from the initial shock, they soon realized that steamer was taking on water and going down at the head.

Captain Gore and his officers attempted to coordinate lifesaving procedures for passengers and crew, but little could be done to save the steamer. The damage sustained by *Anthony Wayne* proved fatal, and the steamer sank to the bottom of Lake Erie within 15 to 20 minutes. During the sinking, the upper cabins and superstructure were ripped free from the hull and stayed afloat. The frightened and

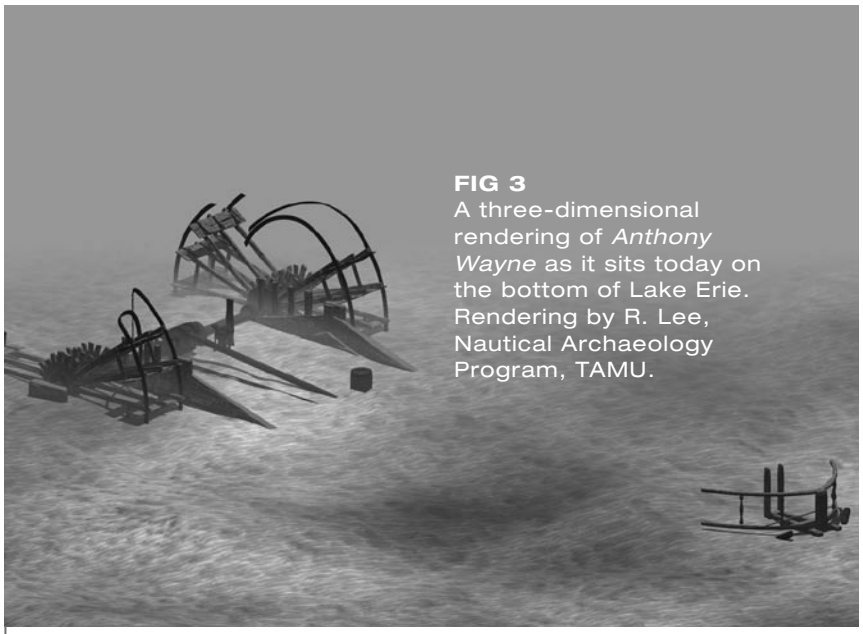


FIG 3
A three-dimensional rendering of *Anthony Wayne* as it sits today on the bottom of Lake Erie. Rendering by R. Lee, Nautical Archaeology Program, TAMU.

injured survivors used this piece of wreckage as a life raft and waited in the cold, dark night for help to come. The captain decided the best option for saving as many people as possible was to make his way to shore and alert other vessels at nearby Vermilion. He and a few others managed to free a partly damaged life boat and with only one oar made their way toward land. The first mate commandeered the ship's yawl and started out toward the schooner *Elmina*, a few miles off to the west. When Captain Gore reached Vermilion, he borrowed a horse and rode back to nearby Sandusky for help. He reached the town at early dawn, woke the major and informed him of the disaster, at which point the steamer *Islander* was dispatched to wreck site. Several hours passed before the first rescuers arrived, and sadly it was too late for a number of individuals. In all, 38 people lost their lives or were reported missing following the disaster.

The exact cause of the boiler explosion was never determined. The coroner's inquest in the days following the incident deemed that all crew members had acted appropriately and in accordance with established protocol. In a fiery instant, *Anthony Wayne* became another grim statistic in the growing number of Great Lakes steamboat catastrophes.

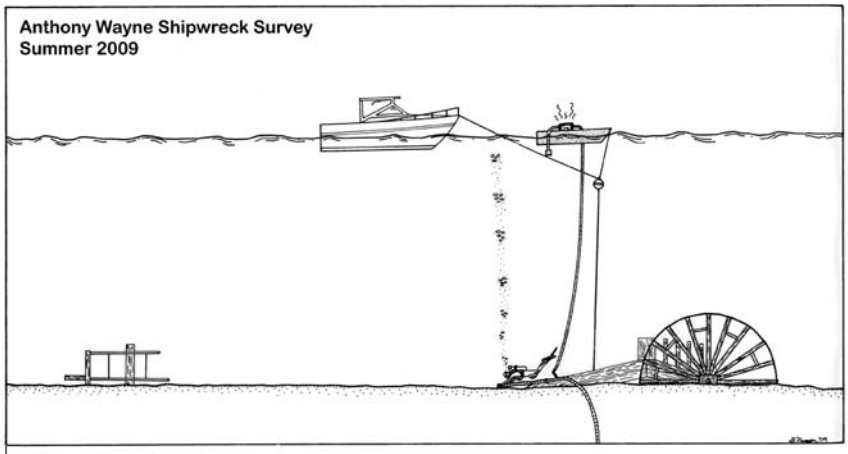
Discovery of the Wreck

The wreck of *Anthony Wayne* rests in 50 feet of water and was discovered in September 2006 by Tom Kowalczk, a member of CLUE. Using a sidescan sonar device and operating off of historical information, Kowalczk carefully searched the suspected area of the wrecking event in hopes of locating a trace of the ill-fated steamer. Six miles north of Vermilion, Ohio, the sidescan revealed two large objects in relative proximity situated well above the lake bottom, indicating the likely presence of a shipwreck (Figure 2). Inclement weather prevented Kowalczk from diving on the site after its initial discovery, but divers from CLUE were able to verify the find in May 2007. The target proved to be an old steamboat broken into two parts: the midships section, complete with two large standing paddle wheels; and the bow section. Given the location of the wreck, the features of the vessel, and its preliminary dimensions, Kowalczk and CLUE concluded that they had indeed located the remains of *Anthony Wayne*. The discovery of the steamer was announced later that summer by CLUE in association with the Great Lakes Historical Society.

Site Description

Anthony Wayne is situated in two parts, with the bow lying approximately 75 feet to the southeast of the midships section (Figure 3). The two sections of wreckage are almost perfectly aligned with one another, with the bow section slightly skewed to starboard. Both bow and midships are half buried in fine mud, and no artifacts or architectural elements are visible on the lake bottom between the two sections. A high degree of biofouling is evident, as zebra and quagga mussels have attached themselves to several areas of the wreck in mass quantity. Where large clusters occur, these mussels obscure all details of the wreck and pose a threat to divers, as their shells can be incredibly sharp. The midship portion of the wreck is, by far, the larger and more impressive of the two. The most striking features are the two large paddle wheels on either side of the vessel, measuring 26 feet in diameter. While the majority of the buckets are broken or missing, most of the arms, originally numbering three on each wheel, are still in place. The buckets are attached to the arms with iron through-bolts and, in one case, a U-bolt possibly used as a repair. Only the upper halves of the paddle wheels are exposed, as the bottom portions are entombed in mud.

Little remains of *Anthony Wayne's* hull. Five frames on the port side and four to starboard protrude from the murky bottom, and rise from the outboard side of the vessel's wooden hogging truss. The diagonal truss timbers run forward on either side of the vessel before disappearing beneath the mud. The port side exhibits the only visible remains of exterior planking attached to the frames. The planks measure 1 inch in thickness and are secured to the frames with iron nails. The paddle wheels are linked by a central iron driveshaft that rests just above the lake bottom. Connected to the shaft are two iron cranks fastened to the vessel's pitman arm. Also present on the driveshaft are two cams and their respective frames. Two connecting rods,



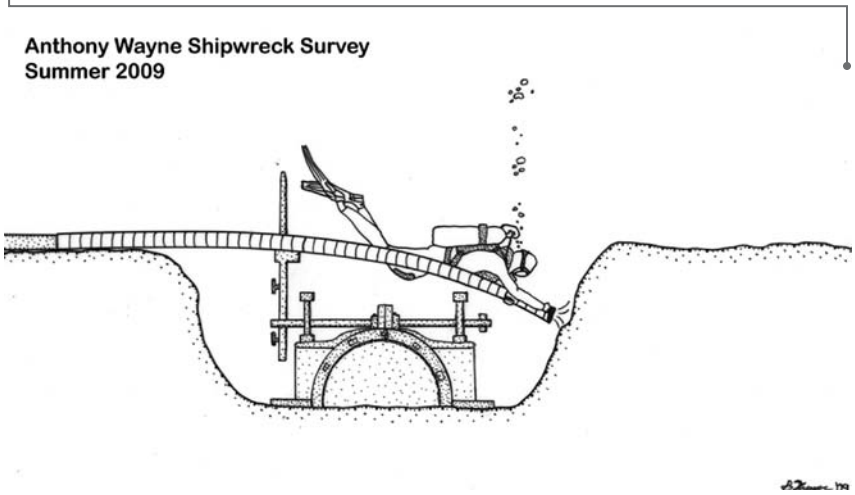


FIG 4 left top
The 2009 dredging set-up on *Anthony Wayne*. Drawing by B. Krueger.

FIG 5 left bottom
Uncovering *Anthony Wayne's* horizontal steam engine. Drawing by B. Krueger.

FIG 6 below
Steam exhaust lever and valve. August 2009. Photograph by D. Van Zandt, CLUE.

or rock shafts, are connected to each cam frame and run forward, parallel to the pitman, into the lake bottom. On the port side of the vessel, immediately forward of the driveshaft, is a frees-tanding crosshead pump connected to a tall vertical timber. There are connections situated on the base of the pump intake, but none of the associated pipes survive. Forward of the pump a distance is the large cylinder that stands alone near where the pitman arm disappears into the mud. The cylinder, believed to be a feedwater heater, rests close to the pitman arm with its opening facing upward.

The remains of the bow lie some 75 feet forward of the midships section. This section is much more scant than the other, but exhibits interesting features. The exposed wreckage is triangular in shape and mainly consists of the rail-cap, spindles, and base, all connected by transverse timbers. While the upper rail is detached from the lower base, some of the spindles remain suspended from the rail-cap. The cap is fitted with a rectangular notch and an iron eyebolt on each side to allow a cable or line to pass through; a third iron eyebolt is found on the vessel's breast-hook. Abaft the apex of the rail are two tall stanchion posts that are attached to a beam that runs athwartships and would have been used in heavy lifting operations. Protruding from the front of the bow are two sturdy catheads that were used to raise and lower the steamer's anchors, each having a heart-shaped tackle situated on the outer side. Finally, beneath the catheads and off to the sides, two large wooden anchor stocks with an iron band barely stick up from the soft mud. The iron shaft and flukes of the anchor are completely buried and could not be assessed.

After being in a waterlogged environment for 159 years, most of the remaining components of *Anthony Wayne* have proved to be resilient. Some of the wooden features are more fragile than others and this is especially true for the thinner pieces such as the buckets and hull planking. The wood is soft and prone to damage or breakage, and great care was taken in examining these elements. The iron components have fared better, although a corrosion layer is present on all ferrous objects. The site appears to be in stable condition at present, although it is unclear how the

presence of invasive mussels will affect the long-term integrity of the site.

2009 Field Season

After a short preliminary field season in 2008, in which the wreck was surveyed and documented, the *Anthony Wayne* Shipwreck Survey resumed investigations in summer 2009. The crew of archaeologists, divers, and volunteers was led by Brad Krueger from Texas A&M University and Carrie Sowden of the Great Lakes Historical Society. Three principal objectives guided this year's operations: first, locate and uncover elements of the vessel's port-side hull; secondly, locate and uncover the steamer's horizontal engine; finally, investigate the stern section of the site, where no visible remains are present.

The crew made their way to the site and underwater excavations were carried out over the six-week field season, the first of their kind in Ohio waters. To do this, a small aluminum skiff equipped with a water pump was towed out to the site every day by the dive vessel, *Dragonfly*. Given the goals and scope of the project, two exploratory test units were to be opened, one on the port-side of the vessel forward of the paddlewheel and another forward of the exposed pitman arm. The first test unit excavated was on the port-side of the vessel (Figure 4). The goal here was to follow the hogging truss timber forward into the mud to see if the team could locate any elements of the hull, i.e. frames, planking, etc. After two weeks, a 12-foot long by 8-foot wide unit was dug that reached a final depth of 8 feet. Unfortunately, the truss timber was the only structural element that was happened upon and no smaller artifacts were uncovered, save for an old beer can from the mid 20th century. Disappointed but not discouraged, the team then decided to probe the bottom of test unit to see if they were close to some type of structure. Surprisingly, all of the probe tests conducted within the unit were positive, but were still 5 to 6 feet deep, too deep for the crew to quickly get at. Time did not allow the team to continue working in this area, as there was still much to do before the season's end.

After work wrapped up on the first test unit, focus quickly switched to the next one. The second unit the team open was just forward of the pitman arm, with the intent of locating and exposing *Anthony Wayne's* steam engine. There were no historical accounts or reports of the engine having been salvaged, so Krueger and Sowden were hopeful that it would still be present on the site in some form. The team began the second round of excavations and followed the pitman arm forward into the mud. It was soon realized that the pitman arm was connected to the engine's robust iron piston via a crosshead linkage. Excited by this, the crew worked diligently in zero visibility conditions for the next three weeks to follow the piston and move away the slimly mud. The hard, arduous work paid off, as the team was successful in uncovering the steamer's fully articulated horizontal direct-acting steam engine (Figure 5). The discovery of *Anthony Wayne's* engine was a truly remarkable find as it represents one of the earliest archaeological examples of a marine engine on the Great Lakes.

Anthony Wayne's engine appears to be generic in style for a 19th-century steam engine. Four exhaust valves and levers adorn the top of the engine which were operated by two lifting arms or wipers (Figure 6). These wipers oscillate back and forth, lifting the exhaust levers, allowing steam to enter the cylinder from one end while be expelled on the other. The wipers are attached to a control rod which is controlled by one or two cam linkages. As the cams rotate on the drive shaft, the surrounding cam frame moves back and forth, thus moving the cam linkages and regulating the amount of steam in the cylinder. Despite the textbook appearance of the steamer's engine, the team did discover some unique features. First, an 'S'-shaped crank was found on the starboard-side of the cylinder, which possibly served as a throttle that controlled the amount of steam entering the engine from the boilers (Figure 7). Secondly, a small ornately crafted globe with attached funnel and lever was found on the aft-end of the engine (Figure 8). This was likely a reservoir for oil or lubricant that kept the engine running smoothly. After the digging had ceased, the crew took great care to carefully sketch, measure, and photograph the steamer's engine and associated machinery. In an attempt to ensure preservation of this unique mechanical artifact, the test unit was back-filled with discarded sediment before the close of the field season. Time restraints did not allow for the thorough investigation of the aft-end of the wreck as initially planned. With no visible remains in the stern area, it is questionable as to whether or not hull remains exist buried in this part of the site. Probing was successful in the forward part of the vessel in 2008, but excavation of *Anthony Wayne's* engine took precedent over starting a new phase of the project. The crew was, however, allowed access to a sub-bottom profiler, a device that emits an acoustic signal powerful enough to penetrate the lake bottom substrate. An afternoon was spent with the device and initial tests did indicate that substantial material does lie buried beneath the bottom abaft the paddlewheels for a distance of at least fifty feet. Further testing must be conducted, either manually or by remote sensing, in order to better define the site and get overall dimensions of the vessel.

Significance

Anthony Wayne and other steam vessels were responsible for the movement of goods, people, and ideas throughout the American frontier in the 19th-century. This old side-wheeler is representative of an age of technological discovery and ingenuity, as well as a time of social and economic expansion. These forces were felt not only in the Great Lakes region, but throughout the United States. The work completed by the *Anthony Wayne*

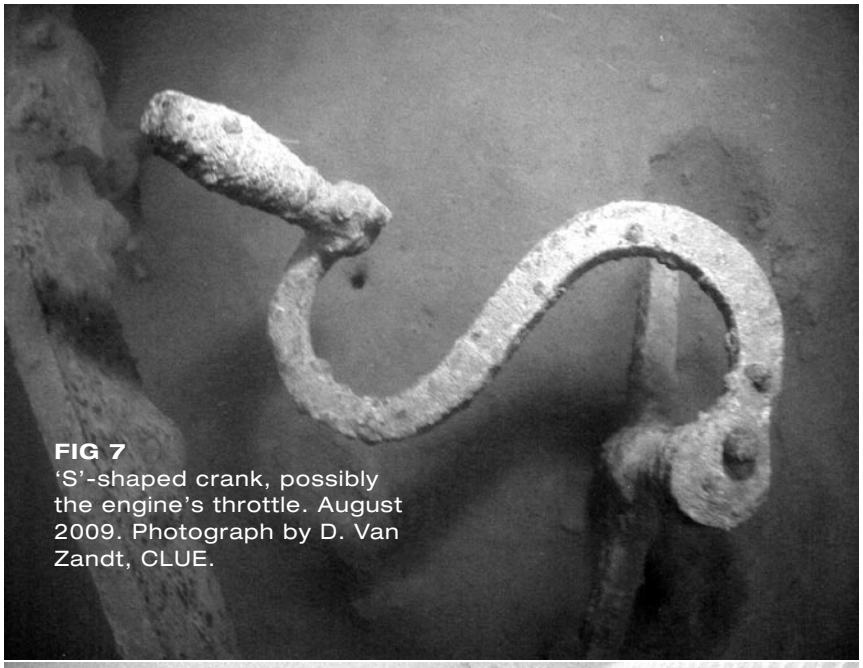


FIG 7
'S'-shaped crank, possibly the engine's throttle. August 2009. Photograph by D. Van Zandt, CLUE.

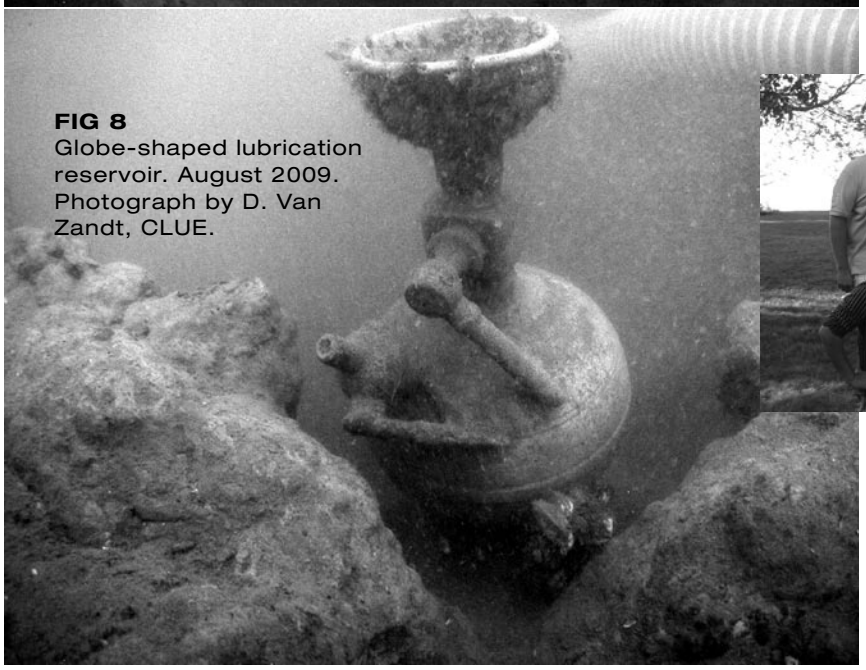


FIG 8
Globe-shaped lubrication reservoir. August 2009. Photograph by D. Van Zandt, CLUE.

FIG 9
Anthony Wayne Shipwreck Survey 2009 crew: (top row, left to right) Matt Mossman, Tyler Cullinan, Tom Kowalczk, Mike Mossman, David Van Zandt; (bottom row, left to right) Will Moser, Carrie Sowden, Christine Misterka, Bradley Krueger; (not photographed) Heather Jones, Taylor Brooks.

Shipwreck Survey will increase knowledge of 19th-century Great Lakes steamboat construction and technology, regional passenger and cargo transportation, and shipboard life on steamboats plying the waters of the Inland Seas.

Acknowledgements

This project could not have been possible without the generous support from the Great Lakes Historical Society, the Peachman Lake Erie Shipwreck Research Center, the Cleveland Underwater Explorers, the Institute of Nautical Archaeology, the Ohio Council of Skin & Scuba Divers, and Texas A&M University. Additional thanks should be paid to Carrie Sowden, Chris Gillcrist, Tom Kowalczk, Kevin Crisman, Jim Delgado, and several enthusiastic volunteers who helped make the last two years such a success (Figure 9).

Berta Lledó INA

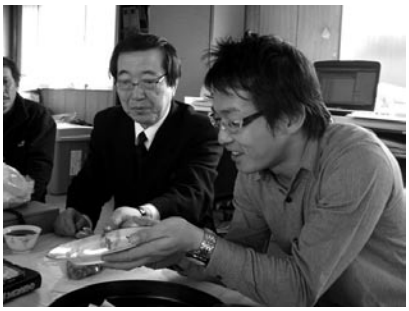


FIG 1 above
Mr. Tanabe examining the *Ertuğurl* Porcelains in the *Ertuğurl* Research Center. Photograph by M. Akagi, February 2009.

FIG 2 right
Perfectly preserved Yokohama plate from Mr. Tanabe's collection. Decorations in this plate are very similar to those found in the *Ertuğurl* pieces. Photograph by B. Lledo, February 2009.

The Frigate *Ertuğrul:* 2009 Highlights

A Campaign Full of Surprises

Japan started limited contacts with the rest of the world with the opening of Yokohama harbor to all international maritime trade in 1859, although some trade relations with specific nations began as early as the 17th century. Because of this trade, Yokohama became the center of the production and sale of Japanese export products, with workshops established to help meet the new demand. But although some of the resultant goods reached the fanciest homes in Europe and the United States, these products were never sold internally, in the Japanese home markets.

One of the goods was Yokohama porcelain, a fine and specific product of high- quality earth with exquisite hand-painted decorations that represent mostly nature scenes of the Yokohama area, with images of lakes, exotic vegetation, flowers, and birds. Because examples of these porcelains are only found outside Japan, they have had to be collected by local experts and brought back to Japan to illustrate an interesting period of Japanese art history.

On its diplomatic mission to Japan, the frigate *Ertuğrul* visited the major harbors of the country, including, of course, Yokohama, the closest anchorage to Tokyo, where *Ertuğrul* spent three months. It is only natural that those on board intended to carry samples of the finest Japanese products back to Istanbul, either as

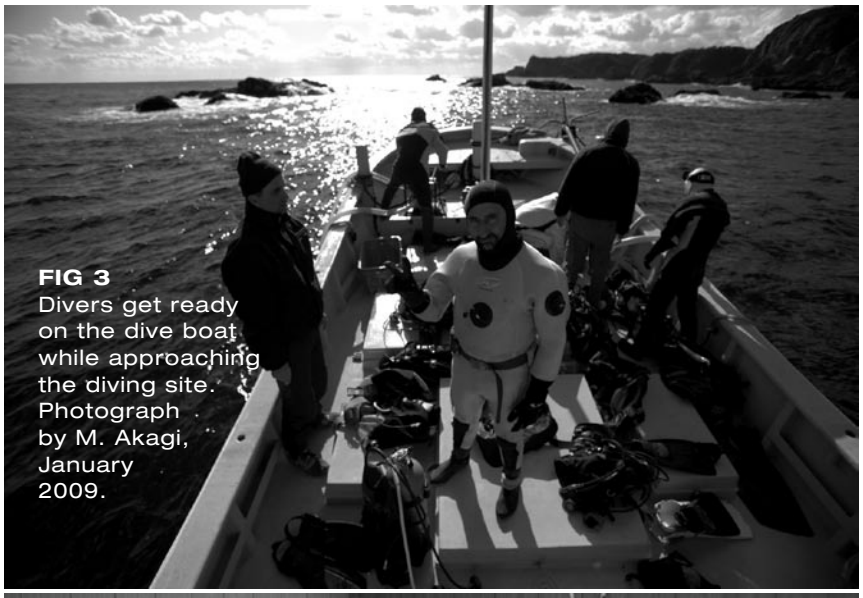


FIG 3
Divers get ready on the dive boat while approaching the diving site. Photograph by M. Akagi, January 2009.

FIG 4
High School students visit the Ertuğrul Research Center in Kushimoto. Photograph by M. Mayumi, February 2009.

FIG 5
The Ertuğrul team and neigbors enjoying an evening meal Photograph by M. Akagi, January 2009.

personal acquisitions by the crew or, more likely, as official presents to the Sultan's palace.

During the 2008 and 2009 excavation campaigns on *Ertuğrul* many fragments and some complete pieces of these rare porcelains were recovered. Mr. Tanabe Tetsundo, porcelain expert from Yokohama, came especially to Kushimoto to examine our pieces and confirm their provenience and importance since, until now, these are the only porcelains of this type found inside Japan (Figures 1 and 2).

During the 2009 excavation season, however, of more than 3,000 artifacts raised from the sea floor, the porcelains discussed here were only a small part

2009 Field Campaign

Field work on *Ertuğrul* shipwreck resumed in January and February of 2009 at Oshima Island, Japan, as the second season of archaeological excavation following the 2007 survey and the first excavation campaign in 2008 (Figure 3).

During the three field campaigns on this rich archaeological site more than 4,000 artifacts have been raised. The first year, consisting of only a survey, yielded 11 diagnostic artifacts. In 2008, the first excavation campaign, the number of artifacts recovered rose to 1,164, while in 2009 the artifact count was 3,534.

The difference between the two campaigns is not only due to more dives and total bottom time (155 dives or 164 h bottom time in 2008 versus 183 dives or 188 h bottom time in 2009) but also to a concentration on richer archaeological levels. In 2008 the team removed a layer of at least 50 cm of loose shells and gravel whereas in 2009 they could start directly in compacted levels.

For the 2009 field work, the Kushimoto municipality provided *Ertuğrul* Project with a research center in town, an old depot building

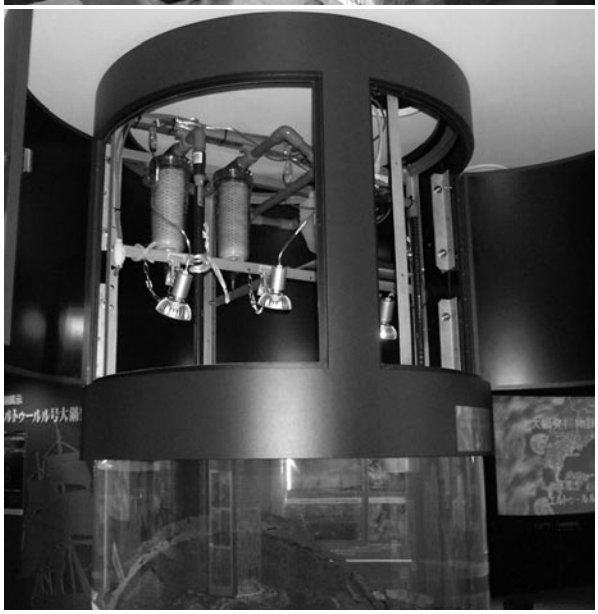
previously used by the community for sporadic meetings and eventually as a youth club. The project rented a traditional Japanese house across the street to be used as living space for the team.

During the first week of the project we habilitated the depot into a fully working archaeological laboratory for the processing and conservation of artifacts, with space for a computer center (Figure 4).

In the center of the lab we had a low set of tables that accommodated up to 16 people. These were used mostly in the afternoons when we welcomed high school students and their teachers for practical sessions on nautical archaeology, and volunteers who came to help with the conservation process. The center was also used extensively for press conferences that the Kushimoto municipality arranged regularly, as well as for our team's evening meals (Figure 5).

During afternoons the influx of volunteers to the lab was extremely helpful. We had a regular group, who varied in age from 7 to 90 years old, who participated in all stages of the process, from receiving the artifacts, to photography, registry, and especially mechanical cleaning. With their help we finished the initial cleaning of many of the thin copper plates covered by concretion, all of the nails, and all of the copper pieces recovered in 2008 and 2009. Some large concretions were also worked with chisels and hammers, which resulted in the recovery of a large number of nails, lead fragments, and other small artifacts that they contained (Figure 6).

During our two-month stay in Kushimoto the desalination process of artifacts in wet storage from 2008 continued. By the end of February, most of the artifacts from 2008 were almost desalinated. Those fully desalinated were slow dried. Among the objects were some concretions and a few copper-alloy objects that were immersed in benzotriazole (more



top to bottom

FIG 6
Volunteer Mr. Haruhisa Sakon removing thin concretion from a copper artifact. Photograph by B. Lledó, February 2009.

FIG 7
Moving the artifacts to the Marine park facilities. Photograph by B. Lledó, February 2009.

FIG 8
Specially designed tank to hold the *Ertuğrul's* cooking pot in the Marine park theme exhibit. Photograph courtesy K. Nomura, Kushimoto Marine Park, June 2009.

commonly referred to as BTA) for 24 hours for stabilization before slow drying.

Although progress in the initial conservation of the artifacts went well, at the end of the 2009 campaign we faced the same problem as in the previous year: how to arrange the desalination and treatment of artifacts after our departure. To solve this issue we agreed on a collaboration plan with the Kushimoto Marine Park (Figure 7).

We were allowed to use several concrete tanks in the storage area of the park, similar to those in the INA Nixon Griffis Conservation Laboratory in Bodrum, Turkey. In them we stored large artifacts (i.e. three copper pipes measuring two meters in length, several large concretions, and the cooking pot which measured 75 cm in diameter and 45 cm high). An adjacent area was designated to hold all the plastic boxes that contained the rest of the artifacts remaining in Kushimoto, with the promise that water will be changed in all the boxes on a monthly basis, thereby improving our storage situation and allowing slow desalination.

The Kushimoto Marine Park, in collaboration with the Kushimoto Municipality, also held a wet exhibit of some of the artifacts in one of their show rooms starting in April 2009. The main theme was the excavation and raising of *Ertuğrul*'s cooking pot. The exhibit consisted of three sections: a picture show of the project, with pictures taken by professional underwater photographer and project member Mazakazu Akagi; a video presentation showing the excavation and raising of the cooking pot; and a display of actual artifacts in two areas: a low tank with open top in which concretions, bullets, and a cannon ball are can be seen and a cylindrical glass tank specially built to contain the cooking pot (Figure 8).

The exhibit raised great public interest which drew a large number of visitors.

Increasing Collection

Since the start of the project all artifacts have been registered in an *Ertuğrul* Project database, and copies left with the Kushimoto municipality in Japan.

During our 2009 campaign the most representative object of the shipwreck was raised: a 75-cm (29-inch) diameter copper-alloy cooking pot. Its recovery was an event that every newspaper in Japan wanted to feature. The raising of the object was done during a press conference at the wreck site, both on the dive boat and under water, organized by the municipality. The cooking pot was then brought to the *Ertuğrul* Center and its lid, still inside the pot, was removed in an official ceremony; the sediment within the pot was sifted in search of any significant remains, a labor which proved unfruitful (Figures 9, 10 and 11).

The cooking pot was the center of attraction in the Kushimoto Marine Park from April 2009 to January 2010 as the central piece of the *Ertuğrul* Project exhibit.

During the 2009 field work, some of the most interesting discoveries were made in the laboratory. For example, one late afternoon we identified a circular shape of an unknown material in one of the large concretions brought that day from the site to be cleaned. When carefully cleaned and opened the concretion revealed a perfectly preserved cast-iron cannon ball with its wooden sabot. (Figures 12 and 13). This was one of the four cannon balls recovered in 2009. Each weighed 12.5 kilograms, with an approximate diameter of 16 cm. Although two of them preserved wooden sabots, the straps that should have been holding the iron ball to the sabot were not preserved. The wooden sabots are still being treated in Bodrum; final cleaning of their thin layer of concretion might reveal more details about these interesting artifacts.

Other artifacts in the same excavation area included a Palliser shell of 7-inch caliber. After it was carefully released from the concreted seafloor and brought to the surface it was transported and handled by the Japanese Army Special Forces

Opposite

FIG 9 (A)
Raising the Cooking pot January 2009
Photograph by M. Akagi, January 2009.

FIG 10 (B)
Tufan is happy to see the Cooking pot safely on deck. Photograph by G. Varinligolu, January 2009.

FIG 11 (C)
H. Enomoto and B. Lledó shifting the cooking pot contents.
Photograph by M. Akagi, January 2009.

FIG 12 (D)
Author works in the lab on a cast iron cannon ball with wooden sabot preserved inside concretion.
Photograph by M. Akagi, January 2009.

FIG 13 (E)
Detail.
Photograph by B. Lledó, January, 2009.

FIG 14 (F)
Palliser shell detail.
Photograph by M. Akagi, January 2009.

FIG 15 (G)
Large shell underwater
Photograph by M. Akagi, January 2009.


A


B


C


D


E


F


G

since wet gun powder, even after 120 years in the sea, can still be dangerous when handled improperly (Figures 14 and 15).

Palliser shells were a type of cast-iron ammunition used in 19th-century naval battles to penetrate enemy ships' hulls. They had a powder-filled cavity, but no fuse, being expected to explode with the shock of impact. According to the literature they were supplied for guns of 7-inch caliber and over. The Palliser shells found in *Ertuğrul* were most likely intended to be used with one of the five 150-lb Armstrong guns carried on board.

Use of gunpowder filled shells was discontinued by the British in the 1880s when their artillery studies showed them ineffective against the new hardened armor developed for naval ships. If the Ottoman navy followed British guidance in these matters, the Palliser shells found in *Ertuğrul* presumably were already old when on board.

Besides the apparent obsolete armament that equipped the frigate in 1890, *Ertuğrul* itself was one of the last ships of her generation to be lost. Already from the mid-1840s frigates were built with steam engines and screw propellers, but they were still fully rigged following the traditional design, which also conserved coal.

Ertuğrul was a wooden frigate of 79-m (260-ft) length, 15.5-m (51 ft) beam and 2,344 tons burthen, launched in Istanbul in 1864 as a sailing ship, and equipped with a screw propeller and two horizontal steam engines of 600 hp in 1865 in Portsmouth, England, to keep up with new international navy trends. Already in the 1870s battleships were taking a whole new design approach; from the early 1880s the American, German, Russian and Japanese naval forces were steel plated, their armaments newly designed for them.

"Screw frigates," built first of wood and later of iron, continued to perform the traditional role of the frigate until late in the 19th century. Toward the end of that century, the term "frigate" fell out of use. Armored vessels were designated as either "battleships" or "armored cruisers," while unarmored vessels including frigates and sloops, were classified as "unprotected cruisers."

A living example of the era of *Ertuğrul* is the friagate *Jylland*, a Danish steam frigate that sailed between 1860 and 1892. It was then used as stationary barracks until World War II. A major restoration program of *Jylland* began in 1960 in Ebeltoft, Denmark, and since then the vessel has been converted into a museum. "The last survivor from the era of wooden-hulled, screw driven warships," *Jylland* could make a good comparative study with *Ertuğrul* due to their similarities in date, size, displacement, and power.

Yokohma Porcelain from *Ertuğrul*, the First Found in Japan

Japanese porcelain production started in the mid-17th century with the discovery of local sources of porcelain clay in the Hirado area. In 1662, a new source of a white-bodied clay was found on Amakusa Island. This discovery led to the creation of Hirado ware. Hirado-ware kilns belonged to just one family, Matsuural, which collected Chinese porcelains and used them as models for their products. The pieces produced in their kilns were only for their private use, to use as presents to foreign dignitaries, or for the emperor's use at court. "Its unavailability added to its mystique." Japanese earthenware products, however, were always second to the Chinese, which were of better quality and refinement. Between 1659 and 1682, for example, the Dutch East India Company carried 190,000 Japanese pieces to Holland, whereas 3,000,000 were imported from China.

In the 1830s some Hirado ware was made available for trade, especially with the Dutch East India Company, although its price could not compete with those of Chinese porcelain of similar quality.

With the opening of Yokohama harbor for international trade in 1859, a whole new line of export products had to be created. Many of them lacked quality and followed European fashion to gain clientele, but this was not the case with some of the very fine porcelains produced in Yokohama, where some of the workshops gained fame for their delicate shapes and decorations. Their fine ware found favor in the imperial palace, and they were the most expensive souvenirs to be bought in the harbor. The decorative style that resulted from combining traditional Japanese porcelain techniques with European and American fashion styles added to its uniqueness.

Following the Meiji-restoration (1868), the Japanese government placed special importance on pottery manufacture, not only as part of a policy to encourage new industry, but also as a way to improve Japan's image in Europe and the United States through the introduction of its high-level art products to the international market.

Although Yokohama was where the workshops were situated and where more than 400 pottery artists were based, the region was not rich in porcelain clay, which had to be imported from other regions of Japan. On many occasions the Yokohama workshops applied only the final decoration on plain white pieces already produced in other areas of Japan.

Chemical analysis of the porcelains found in the wreck of *Ertuğrul* show that their chemical composition is very similar to that of Amakusa's porcelain clay, which is rich in the clay mineral kaolinite. Amakusa, considered to have one of the best quality porcelain clays in Japanese territory, was one of the providers of Yokohama workshops, providing either the raw material or

already-produced white earthenware (Figure 16).

Unfortunately there is little information for the study of the Yokohama productions. Because of both natural and human-created disasters in Yokohama after 1890, these businesses did not continue after their successful period of trade. The Great Kanto earthquake of 1 September 1923 killed at least 30,000 people in Yokohama and destroyed 60,000 buildings. It took more than six years for the city to recover, but only 16 years later, in 1945, during World War II, repeated bombings destroyed almost half of the city, the remaining facilities being confiscated until 1952.

Only recently has this type of porcelain gained interest, thanks to public awareness created by the exhibits of private collectors who have been gathering examples from different parts of the world.

A Piece of Cable

One surprising lab discovery in 2009 was a piece of electrical cable. According to the records, *Ertuğrul* was equipped with electric lighting in 1865 in Portsmouth, an early example of electric applications in ships. The preserved cable recovered from *Ertuğrul* site is only 13 cm long, 6.7 mm diameter, but that is enough to prove this early application of shipwiring (Figure 17).

According to Robert Monro Black, shipwiring became common in the United States only after Americans contacted the Anglo-Brush Electric Light Corporation in the 1880s, but he refers mainly to commercial liners. Surely the application to military ships was earlier. "The earliest types of cables employed for shipwiring were for the electric lighting and ball wiring. The insulated wires used for the lighting circuits consisted of a single strand of copper wire insulated with a layer of pure rubber tape which was then double cotton covered and waxed. Vulcanized rubber insulation was also used over a tinned copper conductor or over a plain copper conductor with an intermediary layer of pure rubber... Nevertheless oil lamps were carried in position and ready for use should the power fail as it sometimes did... The power was supplied from batteries of Leclanche cells. The wiring was generally carried in a wood casing or some sort or moulded conduit. For a two-wired system, a double groove was used and a single groove for an earth return... In these early days, standards of illumination aboard were poor. Ocean liners in the first stages of conversion from oil lighting to electric lighting had one 8- or 16-candle power lamp to serve two cabins and an alleyway. No attempt was made in individual switches since it was general practice to switch the circuits on and off in their entirety."

Whistle

Another interesting artifact found during the 2009 excavation was a carved bone whistle (11.9 cm long by 1 to 2.3 cm wide). It was decorated with geometrical motives of rough incisions on its exterior surface that divided the decorated area into four sections separated by double lines. These sections were decorated by oblique lines that alternate directions, creating a general zig-zag effect. The wider area of the bone, including the sound hole, was left undecorated (Figure 18). The main features of this whistle are similar to those of more sophisticated bosun's whistles, naval signaling instruments usually made of brass or copper, sometimes even of gold or silver. This piece could be a personal possession of one of *Ertuğrul*'s crew, possibly purchased on one of their numerous stops in the Indian and Pacific oceans or even carved and made on board during the frigate's long voyage.

Thanks to a personal communication with paleo-osteologist Juan Antonio

top to bottom

FIG 16
Fragmentary porcelain plate from *Ertuğurl*, unfortunately decoration pigments are not preserved. Photograph by B. Lledó, November 2009.

FIG 17
Cable fragment from the *Ertuğurl*. Photograph by B. Lledó, November 2009.

FIG 18
Carved Bone whistle. Photograph by B. Lledó, December 2009.

FIG 16
Excavation underwater.
Photograph by M. Akagi, January 2009.

Lopez Padilla, of the Archaeological Museum of Alicante, Spain, we know that *Ertuğrul* whistle was carved out of a "right tibia of a small lamb or sheep. The sound hole is on the caudal aspect of the bone, and the widest part (corresponding to the proximal epiphysis of the tibia) shows that the bone has been sawed across. The tibial crest is scraped where there are remains of a small hole that was most likely to pass a string and wear the whistle suspended."

According to Vincent Megaw, an expert on archaeological evidence for simple blown instruments, the piece from *Ertuğrul* "is a simple end-blown pipe or whistle; the—now missing—fipple or block being the wedge which constricts the passage of blown air which impinges on the voicing lip to set up the vibrations which produces the sound, (the piece from *Ertuğrul*) is obviously a simple signaling instrument."

Mr. Corwen ap Broch, who makes and plays replicas of ancient instruments, also commented on our piece, noting that "it must also have had a block inside, more or less under the blunt end of the sound hole, which would have left a narrow opening inside to direct air over the sharp edge and generate the tone." The difficulties of making a well fitted block in a hard material for such an irregular interior surface led Corwen to suggest that wax could have been used. "The pitch could have been altered while playing by making the opening at the wide end bigger or smaller, by inserting a finger into it or by closing the hand around the end. It may have had a range of more than an octave. This would allow it to be played with one hand."

A similar piece, but bearing the sound hole closer to the mouthpiece, is one carved out of whale bone, scrimshaw from 1750, handiwork created by whalers. On many occasions in scrimshaw the engravings were painted to enhance the design; typical pigments were candle black and tobacco, which could well have been used on our whistle since the incisions are of a darker brownish tone whose cause is still to be determined.

And Much More...

It has been difficult to choose just a few objects to highlight our 2009 season on *Ertuğrul*, for many other artifacts than those listed here were found during the excavation, including, for example, a complete small glass perfume bottle, a glass measuring-cup fragment, a Japanese coin, officers' buttons, leather shoe soles, and part of a brass chain. All will be illustrated in future publications (Figure 19).

Acknowledgements

This project would not be possible without the generous financial support of Mr. David Koch and the the Kushimoto Municipality, and the hard work of the 2009 field team members Tufan Turanlı, Berta Lledó, Güzden Varinlioğlu, Can Ataç, Yoshiko Ozawa, Mayumi Mizuno, Yoshuki Nakamura, Hiroshi Enomoto, Toshiyuki Shimano, Mazakazu Akagi, Jorge Boronat-Tormo, Jordi Boronat and Maria Jose Lledó-Solbes, and all the participants in the afternoon volunteer program organized by the Kushimoto municipality.

We are thankful for the collaboration with the Kushimoto Marine Park allowing the use of wet storage for *Ertuğrul* artifacts and for hosting *Ertuğrul* Exhibit.

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Regarding the whistle I would like to thank Prof. Vincent Magow, Dr. Juan Antonio Lopez Padilla, Corwen ap Broch and Leif Bailey, a private whistle collector from the UK.

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I want to express my gratitude to Cemal Pulak for answering my questions whenever I wrote him and especially to George F. Bass for his support, comments and editing when writing this article.

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George Schwarz INA

Phoenix—An Archaeological Investigation of an Early North American Steamboat

Introduction

As early 19th-century North American steamboat companies were struggling for control of navigation rights of the country's northern lakes and rivers, Lake Champlain Steamboat Company launched the second steam-propelled vessel to operate on Lake Champlain. *Phoenix* served as a passenger steamer between 1815 and 1819 until she caught fire en route to St. John, Quebec, and eventually sank on the northern face of Colchester Shoal reef, where her hull remains well-preserved for archaeological investigation (Figure 1). Although the boilers and other machinery were salvaged shortly after its sinking, the hull is largely unburied and accessible for documentation (Figure 2). Preliminary measurements of the hull were taken by the Lake Champlain Maritime Society in 1980, and the results were published in a report the following year.[1] In addition to this effort, more in-depth fieldwork was deemed necessary to reconstruct the lines of this steamboat and elucidate finer details of its construction and operation, which is the purpose of this renewed investigation. As the earliest surviving archaeological example of a steamboat, *Phoenix* represents a perfect focal point for researching the development of steam transportation in North America and the technology and maritime culture that developed as a result. This article summarizes the history of *Phoenix* based on archival research and provides a preliminary report of the two weeks of archaeological documentation that took place during the fall of 2009 with support from Institute of Nautical Archaeology, Lake Champlain Maritime Museum (LCMM), Waitt Foundation, and National Geographic Society.

Steam Propulsion in North America

Serious experimentation with steam-propelled vessels began in the late 18th century. At this time shipwrights were developing viable hull plans to support the steam machinery, and, in 1790, John Fitch launched the first commercial steamboat venture in North America, named *Steamboat*. By 1807, partners Robert Fulton and Robert Livingston had built *North River Steamboat of Clermont*, which obtained an

average speed of five mph. Over the next several years the speed and hull characteristics of these vessels improved and the economic advantages of these large steam-driven ships became more apparent. [2]

In 1811, businessman Elihu Bunker launched two steam vessels on the Hudson River, but lost a court case to Fulton and Livingston who had obtained a monopoly of steam navigation in the state of New York in 1807. Three of Bunker's investor's, however, gained the right to navigate in Lake Champlain and created the Lake Champlain Steamboat Company. After the War of 1812, this newly-formed company launched *Phoenix*, the second steam-propelled vessel to operate on the lake after the steamboat *Vermont*, built and launched by the Winan brothers of Burlington six years earlier.[3]

Phoenix was a wooden paddle wheeler 146 feet (44.5 meters) long, with a 27 foot (8.2 meters) beam and 9 foot 3 inch (2.8 meters) depth in hold. It displaced 336 tons and had a 45 horsepower cross-head engine built by Robert McQueen of New York City. It was one of the first vessels to combine the characteristics of both steamers and sailing vessels, with a deep draft and mast stepped well forward in the hull. *Phoenix* had a canvas awning draped over the main deck and elegant cabins for ladies and gentlemen below deck. The steamer was also designed with a small state room, lounge, smoking room, barber shop, kitchen and pantry, captain's office, and luggage compartment. A railing was fitted around the boat, but the main deck was not used by passengers as in later ship types.[4] For four years *Phoenix* maintained a regular schedule between Whitehall, NY, and St. John's, Quebec, with other port stops along the route. It is considered one of the lake's most historic wooden vessels and was used to transport both President James Monroe in 1817 and the remains of General Montgomery in 1818.[5]

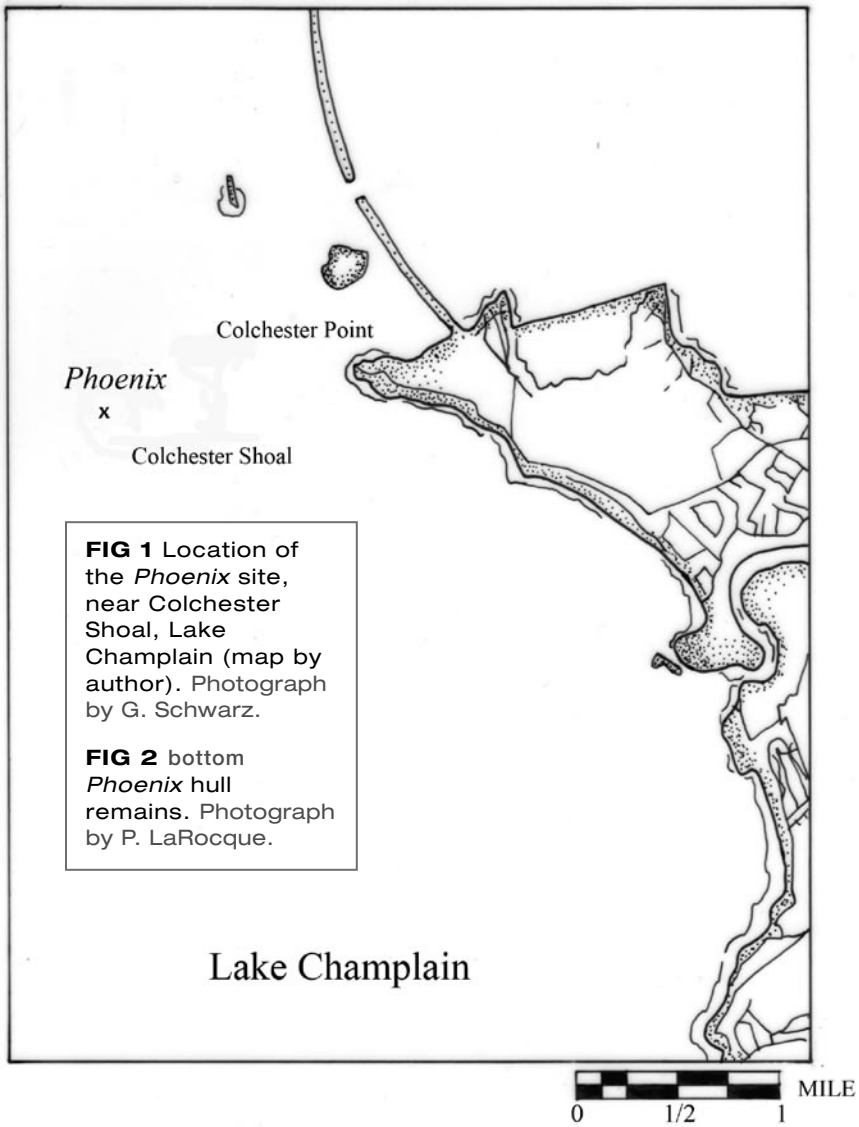

FIG 1 Location of the *Phoenix* site, near Colchester Shoal, Lake Champlain (map by author). Photograph by G. Schwarz.

FIG 2 bottom *Phoenix* hull remains. Photograph by P. LaRocque.

The Sinking of Phoenix

On the night of 4 September 1819, with a total on board of 46 passengers and crew, *Phoenix* left Burlington for St. John's, Quebec. Encountering a violent gale, the steamer pushed ahead, reaching the broadest part of Lake Champlain by approximately 1:00 a.m. According to contemporary accounts, a candle left in the pantry caught the upper shelves on fire which quickly spread throughout the vessel. [6]

Upon hearing the alarm, the captain rushed to the deck and assembled all hands. While trying to lower the boats, flames burst through the deck planking and engulfed the mast and chimney. Accounts describe how the helmsman held fast to the wheel until his arms and legs were scorched and his shirt was half burned off his back. The increased heat at the boilers gave the engine a renewed vigor. One passenger later recalled the chaos: "...the boats were down, and the captain and his men held shrieking women and children in their arms, when the helm gave way, and the vessel, turning from the wind, flew backwards, whirling round and round from the shore. None could approach the engine; its fury, however, soon spent itself, and left the flaming wreck to the mercy of only the winds and waves".[7]

The captain and crew helped the struggling passengers into the boats, successfully rescuing all but six people who drowned during the disaster. It was no more than five minutes from the initial discovery of the fire until all passengers and crewmembers had left the ship.[8] *Phoenix* drifted steadily before running aground in approximately three feet of water at Colchester reef, burning to the waterline.[9]

Overview of Archaeological Research Goals

Historical research has produced sporadic facts about *Phoenix*'s brief four-year career as a passenger steamer as well as rough descriptions of the steamboat's physical appearance. Few facts regarding construction features, navigational qualities, and steam and sail characteristics, however, have been uncovered. This is due in part to the fact that no known plans of *Phoenix*'s design have survived to be studied.

The early days of steam travel were challenging and hull design varied greatly, as is evidenced by the French steamboat observer Jean Baptiste Maristier in *Memoir on Steamboats* (1824). Details about the shape of the hull and placement of machinery during the beginning of the 19th century are not well understood. We do know that there were many problems with the early river steamers, a fact noted by Mark Twain in *Life on the Mississippi*, who stated that even as late as 1840, the distance between St. Louis and Cairo, IL (200 miles/322 kilometers) averaged one wreck per mile (1.6 kilometers).[10] Through this and other 19th-century passages we can confirm that many designs were tested and abandoned throughout the development of steam-propelled vessels. Analysis of data collected from the hull of *Phoenix* can help answer questions regarding structural design, hull shape and hydrodynamic performance, placement of heavy steam machinery, longitudinal hull reinforcement, and compartmentalization of steam vessels.

Previous Work and Archaeological Comparisons

A preliminary site plan of *Phoenix* was produced by members of the Lake Champlain Maritime Society in 1981. During a brief return to the site in 1984, the Society recovered a small number of exposed artifacts, including ceramics, bottle glass, and coins. While preliminary reports have been published detailing these early investigations,[11] a thorough survey of the hull timbers has yet to be conducted. The hull plans that were prepared are conjectural, based on limited hull measurements, contemporary reports, and comparisons with later 19th-century steamboats.[12] The only other recorded research concerning *Phoenix* involved the 1984 ceramics collection, which was the focus of a master's thesis for the Department of Anthropology at Texas A&M University.[13] This investigation was not intended to elaborate on the hull design or location of steam machinery, however, focusing instead on analysis of the artifact assemblage and the study of life aboard passenger steamers.

Archaeological examples of similar vessels from this period include steamers *Vermont*, *Ticonderoga*, and *Lady Sherbrooke*. Scant evidence exists for the hull characteristics of *Vermont*, the first steamer to be launched on Lake Champlain in 1808.[14] Although discovered in the 1950s and raised from the Richelieu River, conservation efforts were nonexistent and the vessel slowly rotted before a thorough examination and recording of the hull could be completed. Nevertheless, some basic hull data is preserved in the unpublished notes of Lake Champlain maritime historian A. Peter Barranco, Jr (on file at the Lake Champlain Maritime Museum). *Ticonderoga*, constructed at a shipyard in Vergennes, Vermont, was originally intended as a steamer for Lake Champlain but was purchased by the U.S. Navy and converted to a 17-gun schooner for the War of 1812. Although the hull remains have been warped over time due to exposure to the elements, the timbers are on display in Whitehall, New York, and were recorded by Dr. Kevin Crisman (1983). *Lady Sherbrooke* (1817-1824) was discovered in the St. Lawrence River and was archaeologically excavated and recorded in the 1980s.[15] Reported to be the sister ship of Fulton's *Chancellor Livingston*, this vessel exhibited some informative details about early steamers and is an excellent comparative example for the study of *Phoenix*.[16]

2009 Fieldwork

The 2009 fieldwork on Lake Champlain marked the first field season (since the 1980 efforts) for conducting archaeological investigations and data recovery on the *Phoenix* site, and was executed under an archaeological permit granted by the Vermont Division for Historic Preservation. The goal for the first year of work was to record the offsets of the extant hull in

FIG 3
Loading gear onto the work vessel *Neptune*. Photograph by T.M. Fraga.

FIG 4
Setting the 6" x 6" squares near the keelson for the photomosaic. Photograph by P. LaRocque.

order to begin creating a complete archaeological site plan and construction drawings for *Phoenix*.

The team was able to stage its headquarters at Stave Island, approximately three miles from the *Phoenix* buoy. This was made possible through LCMM benefactors Bill and Dawn Hazelett, who took great interest in the project. The island was an ideal base, with two large houses on either side of the island for staff members and the two caretakers who were also on the island through the duration of the project. The small harbor also served as a shelter for the research vessel during foul weather days, and proved a useful training area for underwater experimentation of new ideas and equipment. Golf carts were used to transport gear from the house to the harbor and research vessel. Staging from the island also permitted the team to observe the sea state first hand before preparing for daily dive operations, saving the project valuable time.

Dive operations and hull recording took place at the *Phoenix* site between 28 September and 7 October 2009. The crew typically left the island in the 40-foot workboat *Neptune* at approximately 8:30 am daily, unless foul weather was predicted or present (Figure 3). Once Neptune was safely moored over the *Phoenix* buoy, the first of two daily dive rotations prepared for diving.

The first week of fieldwork was spent recording the offsets of the extant hull timbers, from the intact keelson to the outer extremities of the surviving frames. This data was obtained in order to create a site plan and document the vertical and horizontal extent of the hull. Plastic tags, numbered 1 to 76, were attached to the frames. Depth gauges were used to get the heights of the measurements taken at the keelson and the extreme-most portion of each frame for which a measurement was taken. In addition to taking the offsets, the team began recording the frame curves. Digital goniometers in underwater housings were used to measure the angles of the frames to reconstruct the vessel's lines. Some team members were also recording basic construction features such as variations in keelson thickness, planking thicknesses, and bow cant frame features.

The second week of the project was an effort to capture high definition video footage of the wreck site and create a photomosaic of the remains of *Phoenix*. In addition to the plastic numbered tags, the team cut 6" x 6" squares out of colored paper which were subsequently laminated so that they could be taken down to the site. These squares were placed approximately every three feet (91 centimeters) along one side of the wreck (Figure 4). The objective was to have one square visible in each frame of the video footage, to be used as a measurement guide when using the video to aid in creating the site plan and construction drawings. By using the computer software iPhotoMeasure™, the dimensions of the 6" x 6" squares were entered into the software program and a digital measuring tool was created.

Preliminary Results

The majority of the data collected from the 2009 field work has yet to be pieced together to complete the lines and construction drawings, and a long list of measurements will be recorded during the 2010 field season before a comprehensive look at the hull remains is obtained. A preliminary draft of the wreck site from frames 22 to 76, however, was generated for purposes of illustrating the recorded features from 2009 (Figure 5). Between frames 30 and 51, only every other frame is shown in the drawing, as this section is where much of the surviving ceiling planking was located. As evidenced in the previous archaeological investigation of *Phoenix*, the extant remains of the steamer are in good condition overall. As on many other wooden shipwrecks

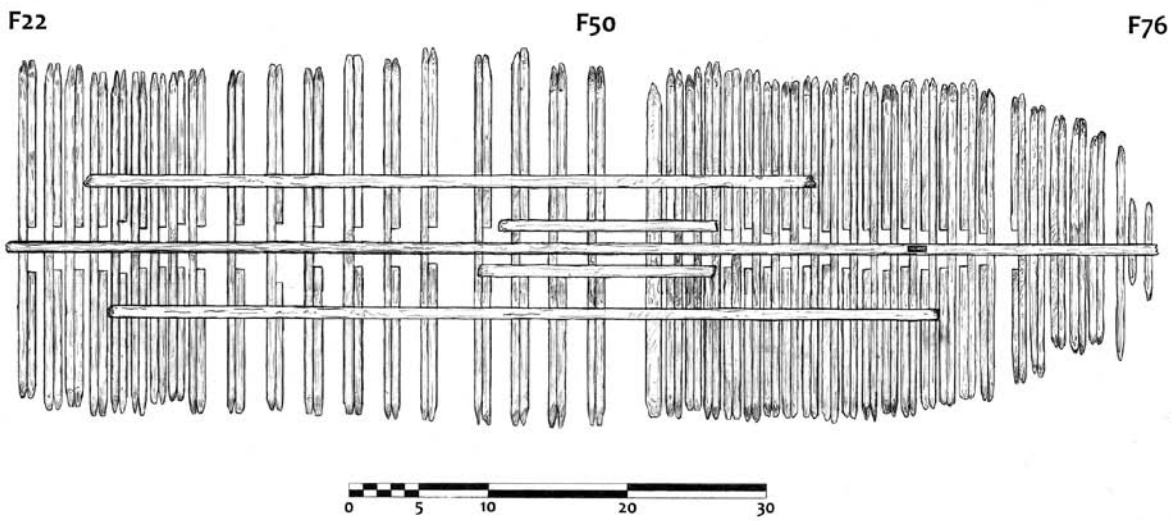

FIG 5 Sketch of site plan from the 2009 field season, frames 22 to 76. Drawing by G. Schwarz.

of the northern lakes, a layer of exotic and invasive zebra mussels (*Dreissena polymorpha*) now covers many features of the wreck site, complicating the documentation of the hull. Also, despite the sound integrity of the hull, the extremities of the frames—in particular those at the stern section—are charred to the point of being extremely brittle. The existing length from stem to stern is 127 feet (38.7 meters), and maximum width of the site is approximately 25 feet (7.6 meters). The floors and frames are structurally sound (except for extremities) and in many cases the frames curve upwards at a considerable height off of the lake bed. In addition to the well-preserved frames, the keel, keelson, ceiling planking, outer planking, stringers, stem, sternpost, deadwood, and bow cant frames are mostly exposed and intact for study. Though some of the basic construction features were recorded throughout the 2009 field season, the structural characteristics of the hull will be the focus of the 2010 field season.

The baseline was laid across the exposed keelson, which ran the length of the vessel. The keelson was approximately 9 to 10 inches (22.8 to 25.4 centimeters) squared. At frame 22 on the port side, the keelson, floor timber, and keel had separated, showing that the floor timber had been notched to receive the keelson.

Phoenix was constructed with a total of approximately 76 square frames, which averaged 9 to 10 inches (22.8 to 25.4 centimeters) sided and molded, though these scantlings varied widely at times as well, with molded dimensions as low as 6 inches (15.2 centimeters) in some areas. The distance between frames averaged 4 to 6 inches (10.6 to 15.2 centimeters). The bow cant frames and stern timbers varied considerably as the breadth narrowed at the extremities of the vessel. Despite some variation, the frame dimensions are similar to those recorded from USS *Ticonderoga*, which was originally built by Lake Champlain Steamboat Company and intended as a lake steamer before being converted into a warship during the War of 1812.[17]

According to contemporary accounts, [18] *Phoenix* was known to have had at least one ancillary sail to complement the cross-head steam engine when opportune. A mast step, measuring 1 foot 4 inches (40.6 centimeters) long by 6.5 inches (16.5 centimeters) wide, was recorded on the keelson at frame 64, approximately 1/3 the length of the boat aft of the stem (Figure 6). No evidence for a second mast step has so far been discovered.

Two pairs of longitudinal stringers, positioned to reinforce the heavy steam machinery, were found along the length of the keelson. Two stringers on either side of the hull were located approximately 3 feet (91 centimeters) from the keelson, fastened to the underlying frames by large drift bolts. These timbers averaged 10 inches (25.4 centimeters) sided and molded, and survived to varying degrees over a length of 40 frames (Figure 5).

Planking thicknesses varied according to function and location on the wreck. A considerable amount of ceiling planking had survived between frames 54 and 39, particularly on the port side. The ceiling planking was typically 10 inches (25.4 centimeters) sided by 1.5 to 2 inches (3.8 to 5 centimeters) molded. Hull planking dimensions at the bow ranged from 5.5 to 6 inches (14 to 15.2 centimeters) sided and 1 inch (2.5 centimeters) molded.

The creation of the site photomosaic is still in progress, but the imagery has been successful thus far in highlighting construction features for cross-reference of recorded site features from the underwater work. The extent of the usefulness of iPhotoMeasure™ software for measurement of wreck site features is still undetermined, but was a good exercise for archaeological site recording

FIG 6
The mast step is a notched portion of the keelson.
Photograph P. LaRocque.

and much was learned in the few days that were spent capturing the imagery which can be used to improve future efforts.

Concluding Remarks

The data recovered from the first field season have shown that *Phoenix* was solidly constructed of closely spaced and fairly robust frames, akin to the scantlings recorded from USS *Ticonderoga*, a 17-gun schooner employed by the US Navy during the War of 1812. The four stringers were approximately the same dimensions as *Phoenix*'s keelson, demonstrating that longitudinal reinforcement for the steam machinery was a primary concern to the shipbuilders. As discovered during the 1980s field operations, a single mast step was located approximately 1/3 the distance of the ship abaft of the stem. While a significant portion of the stern post and supporting timbers have survived from *Phoenix*, timber measurements in this area are incomplete and will be part of the focus of next year's field season.

Through further analysis and interpretation of historical documents, recovered artifacts, and the archaeological hull remains of *Phoenix*, there will be an opportunity to learn more about construction techniques, steamboat sailing capabilities, early steam engine performance, and life aboard steamboats in the early 19th century. The 2009 field season was one phase of a multi-year project intended to contribute to our knowledge on the design and function of early steamers and the ways in which they fit into North American maritime culture and the overall history of technology.

Acknowledgments

I would like to thank Dr. Kevin Crisman of Texas A&M University for supporting this project and providing his notes and drawings from previous research on *Phoenix*. Likewise, a debt of gratitude is owed Art Cohn, Director of Lake Champlain Maritime Museum, for his fieldwork participation, advice, research notes, and expending museum resources on the study of this important archaeological site. A final thank you is sent to all members of the 2009 field team for their hard work and dedication in documenting the remains of the steamboat *Phoenix*.

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Notes

1 Davison 1981.
2 Simmons 1996, 189–206.
3 Ross 1997, 23.
4 Hemenway 1867, 689; Heyl 1956, 199; Sherman 1976, 25.
5 Davison 1981; Simmons 1996, 189–06.
6 Hemenway 1867, 689.
7 Wright 1821, 218.
8 Platt 1819; Northern Sentinel, 10 September 1819.
9 National Standard, 8 September 1819.
10 Twain 1923.
11 Davidson 1981; Haddan 1995.
12 Crisman 2007. pers. comm.
13 Haddan 1995.
14 Ross 1997, 24.
15 Belisle and Lépine 1988
16 Schwarz 2010, 300–301
17 Crisman 1983.
18 Wright 1821, 217.

Heather Hatch INA

Harbour Island Archaeological Survey—2009 Field Season

The concept of 'maritime culture' has become popular across numerous disciplines interested in examining human interactions with Earth's waterways. Despite this popularity, maritime culture is a concept often taken for granted by anthropologists, archaeologists, and historians dealing with coastal and shipboard communities. What does this term mean, what does it encompass, and can it be identified as a distinct subset of a broader cultural identity?

The Harbour Island Archaeological survey aims to answer these questions by examining material culture collected from an established maritime community with archaeological assemblages from other sites from the same period that are less focused on the oceans for subsistence and economic prosperity. With the 2009 field season, August 1 to August 23, procurement of that collection began. Project director Heather Hatch and her small team of fellow Texas A&M University

FIG 1
Bahamas map.
The World Factbook 2009.
Washington, DC: Central Intelligence Agency, 2009.

graduate students, Claire Collins and Larkin Kennedy, surveyed four properties: two located within the oldest part of the settlement, and two others bordering this area. In addition, the team examined and recorded six cannon located on the south-east point of the island that may be associated with an 18th-century fort.

Historical Background

Settlers from Bermuda shipwrecked on the Devil's Backbone Reef off of Northern Eleuthera in the Bahamian archipelago in 1647. After spending the first few years eking out a meagre existence at the site still known as Preacher's Cave, some of these Puritan refugees dispersed to other Bahamian islands to seek sanctuary from the Spanish. One place they settled was Harbour Island. This small island, three miles long by a half mile wide, is situated off the north-east coast of Eleuthera (Figure 1). The two islands form a well-protected natural harbour that attracted colonial settlement. Two early maps of the island, one from 1702 and one from 1718 (Figure 2, Figure 3), show a cluster of houses, and later a small town, arranged around the harbour. John Murray, Earl of Dunmore, officially founded the modern settlement, Dunmore Town, in 1797. It is located in the same area shown on the earlier maps—likely this was an official affirmation of the existing layout.

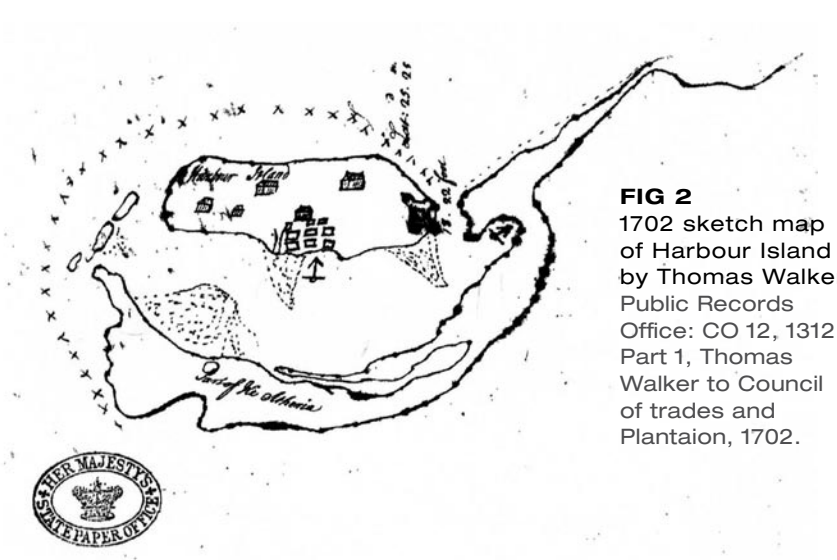

FIG 2
1702 sketch map of Harbour Island by Thomas Walker. Public Records Office: CO 12, 1312 Part 1, Thomas Walker to Council of trades and Plantaion, 1702.

FIG 3
1718 map of Harbour Island by Thomas Cockram. Note that the compass rose is incorrect—the island is shown with its southern end facing the top of the page. Courtesy of R. Malcolm.

The life of early Bahamians was maritime-oriented: settlers hunted turtles and seals, salvaged wrecks (colloquially referred to as 'wrecking'), raked salt, and beachcombed for valuables such as ambergris in addition to being sailors, shipwrights, ship owners, pirates, and merchants. Exploitation of both natural and cultural resources of the maritime environment was an essential aspect of their survival. The limited historical records indicate that these people saw themselves as dependant on the sea, and that they preferred this mode of life. In 1682, the governor of Jamaica described the islands as "barren and good for little, frequented only by a few straggling people who receive such as come to dive for silver in a galleon wrecked on that coast."[1]

During the War of Spanish Succession (1701–1714), the Bahamian colonies were attacked several times, and the main settlement at Nassau was destroyed. However, a number of families remained on both Harbour Island and Eleuthera. Those at Harbour Island constructed a small fort for their protection.[2] There was no official government during this period, however, and opportunistic salvers and pirates began to operate out of the ruins of Nassau. A 1717 report notes that in addition to rebuilding the fort at Nassau, the pirates established a battery at

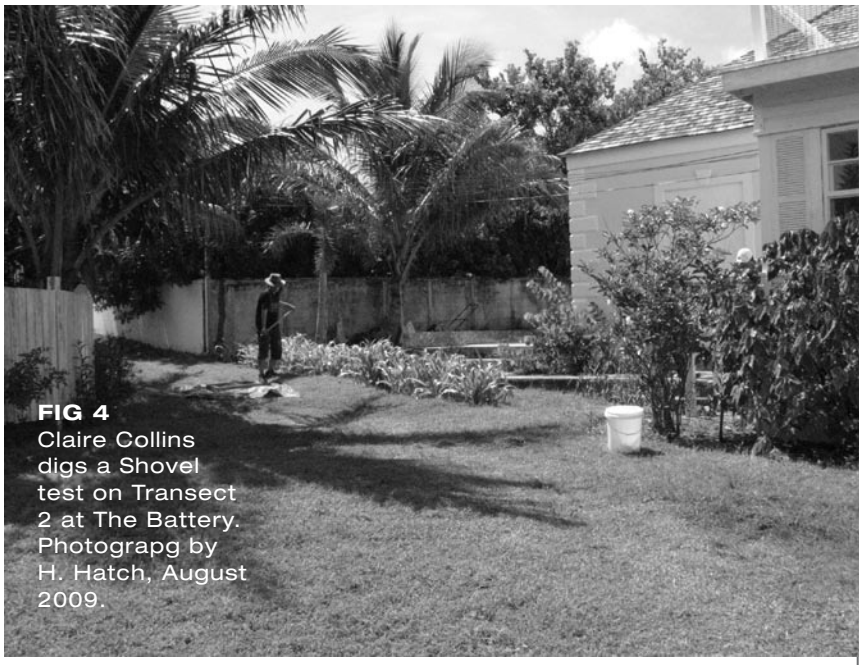

FIG 4
Claire Collins digs a Shovel test on Transect 2 at The Battery. Photograpg by H. Hatch, August 2009.

Harbour Island.[3] All in all, the relationship between the locals and the outlaws was fairly cozy—pirate captain Thomas Cockram married the daughter of the richest Harbour Island merchant, Richard Thompson.[4]

The return of government saw these outlaw mariners absorbed into the population, with Cockram creating a map of Harbour Island for Governor Rogers in 1718. Both Rogers and George Phenney, who served as governor between the former's two stints in office, noted that the population was engaged in the same, primarily maritime, pursuits as during the 17th century, especially trade, salt raking, and wrecking.[5] By the 1730's, colonists were also involved in shipbuilding, though it is not clear if this industry developed throughout all the settled islands in this early period, or centered primarily on New Providence.[6] The earliest shipping register (from 1826) lists at least one vessel, the Eagle, launched at Harbour Island in 1796.[7] Earlier records do not distinguish between the islands.

Patterns established in the early colonial period (c. 1647–1783) persisted at least to the Loyalist period (1783-1834), when Col. Andrew Deveaux led an expedition to recover the Bahamas from the Spanish. The expedition collected volunteers from Harbour Island and various locations along Eleuthera. The islanders contributed many small boats as well as men. Deveaux was a Loyalist, originally from South Carolina, and he and many of his fellow planters took up residence in the islands in the period immediately following the American Revolution.

Generally speaking, the influx of planter households, and especially their slaves, drastically altered Bahamian society. Settlers in older out-island communities, such as Harbour Island, were less impacted by the economic transformation taking place on New Providence and more recently settled islands.[8] Nevertheless, a number of Loyalists did settle in Dunmore Town when it was founded in 1797, though the majority of lots were assigned to others, likely those already in residence. A number of cottages in the old town areas date from this period, and they are believed to be the oldest on the island.

The Harbour Island settlement retained its maritime character well into the 20th century, with boat and ship building remaining a major local industry through the 20th century, and wrecking until the end of the nineteenth.[9] Today, the main industry is tourism based on the natural beauty and relative isolation of the island, its award-winning beaches, and friendly people. Local residents continue to exploit both natural and cultural maritime resources.

2009 Field Season

Although this project is focused on a maritime question—the nature of maritime identity—it relies on more traditional field methodology. At each of the four properties investigated, we lay transects across each property and dug shovel tests at 3-m intervals to collect materials and investigate the nature of the local archaeological deposits. Although the town has been settled for over 300 years, the nature of the local geology and the action of hurricanes and other severe storms means that most deposits are quite shallow and it is difficult to date materials stratigraphically. This makes both the artifacts themselves, as well as the historical records related to the town, the most useful tools for dating the properties.

Two of the properties sampled, the Little Boarding House and the Royall Lime, lay within the confines of the boundaries of the town as depicted on the early maps, directly across Bay Street from the harbour. The others, the Battery and the Administrator's House, lay on the margins of the early town, but were settled in the late 18th or early 19th centuries. The team recovered a mix of historical archaeological materials from all four properties, including ceramics, historic glass, pipe fragments, bits of metal (mostly nails), and faunal remains (shells as well as fish and animal bones). In total, we collected over 7000 artifacts from all the sites investigated. These materials were coarsely catalogued in the field and are undergoing further analysis and conservation at Texas A&M.

The Battery

The first property we surveyed, the Battery, belongs to local historians Anne and Jim Lawlor, and has belonged to Anne's side of the family, the Alburys, since the mid-19th century (Figure 4). Previous owners have been ship captains, merchants, and shepherds—often all at the same time. The Lawlors have been very supportive of the project, and were happy to have us investigate their property. Because it was the first site investigated, and thanks to the patience of the Lawlors, we spent more time on this property than any of the others. We excavated 23 shovel tests on two intersecting transects, crossing as many different zones of the property as possible. We also collected surface artifacts.

The Battery is bounded directly by the town harbour, which may explain the high numbers of fish bones and shells recovered. Despite knowing that at least one 19th-century occupant kept sheep on the land, there was no related faunal evidence. The ongoing analysis of the ceramic remains linked to this property suggests that the late-18th through mid-19th centuries are well represented archaeologically. Some materials may date to the mid-18th century (Pre-Loyalists Colonial era), although the property lay outside the bounds of the early community. It not known at what point the land was cleared of the tropical hardwood coppice that covers the island, but it may have served as pasture before the house was built.

FIG 5
Claire Collins digs a Shovel test on Transect 2 at The Battery. Photograph by H. Hatch, August 2009.

FIG 6
Possible cistern on the north lawn of the Administrator's House, with wall remnant behind. Photograph by H. Hatch, August 2009. (photo 272)

The Administrator's House

The second property surveyed was the Administrator's House (Figure 5). This is the location selected by Lord Dunmore, Governor of the Bahamas from 1787–1796, for his personal residence. Dunmore officially founded the town (named after him), though it had existed since at least the 1690s. The property is located on a hill overlooking the harbour, directly above the modern government dock. The land would have been just on the eastern outskirts of the town in the 18th century, and is located close to the Anglican Church, one of the oldest in the Bahamas. Elite control of the property has persisted since Dunmore's time, and it is currently the government estate assigned to the regional Administrator. The large house that sits on the property has fallen into disrepair, and is currently undergoing renovations.

We lay one transect of 16 shovel tests on the north lawn, running roughly east-west, and surface collected on the entire property. We chose the north lawn both

FIG 7
Larkin Kennedy laying in the transect at The Little Boarding House, Dunmore Town. Photograph by H. Hatch, August 2009.

FIG 8
View of the 'hotel yard' at The Royall Lime from above the retaining wall.

because it offered the largest expanse of ground, and also because a summer camp was hosting a number of activities both inside the house and on the south lawn. The transect ran down hill, starting at the eastern boundary fence, toward the planters framing the walkway on the on the downhill slope. This layout covered the largest stretch of land possible, as well as multiple elevation zones.

At the top of the hill, we encountered a layer of pink sand over a meter thick. This may be natural soil, as deep deposits of similar sand cover most of the island highlands. However, it may also be fill associated with either landscaping or the construction of the road that runs along the eastern boundary of the property. We recorded a number of other features on the lower area of the north lawn, including several segments of the base of a stone wall, a partially filled in cellar-hole likely associated with the standing building, and a roughly circular stone enclosure approximately 1.8 m in diameter that may represent an old cistern or a landscaping element (Figure 6). Additionally, where the transect passed between these features and the house, we encountered a layer of sandstone slabs over the natural soil (or in some cases laid on top of the bedrock) that may represent more walls or perhaps an associated floor.

At this site, the team observed more high quality ceramics and animal bones during the collection process, which may reflect status differences in the community. It is also possible that the low walls located on the north lawn may represent an outside kitchen, which could also explain the generally higher levels of faunal remains in shovel tests from the area.

The Little Boarding House

The Little Boarding House, the third property surveyed, is another mid-19th century house (Figure 7). The landowners had acquired the property earlier that year, and could provide only cursory information about the building and property history. This is one of many rental properties available in the heart of Dunmore town—many property owners are not fulltime residents, but visit only for a few weeks or months each year, and let the properties to tourists during the rest of the spring and summer. The Little Boarding House is located in the heart of the old colonial town, just across the street from the harbour and within sight of the modern government dock.
We lay two intersecting transects at this property. The first, running approximately east-west, crossed all three low terrace levels in the yard north of the house. On the westernmost terrace, close to the

FIG 9
Claire Collins (left) and Larkin Kennedy (right) discussing the location of the transect at The Royall Lime, Dummore Town. Photograph by H. Hatch, August 2009.

FIG 10
Cannon 3 (foreground) and 4, with stone walkway exposed, South Bar, Harbour Island. Photograph by L. Kennedy, August 2009.

street, we crossed the foundation of an older building. The foundation, dug into the bedrock, was over a meter deep (the maximum reasonable depth for a shovel test), and we could not reach the bottom. The foundation had been filled in with the same mostly sterile pinkish white sand encountered at the Administrator's House, likely from the highlands or the island's eastern beach. We skipped a second test pit that also crossed this feature. Further historical research may uncover details of the building that once stood on the spot.

The second, shorter transect crossed the first just west of the foundation. In total, we placed 13 shovel tests, and excavated twelve. As with the other properties, we also collected surface artifacts. Although this property is within the oldest boundaries of the town, artifacts from more recent occupations appear to dominate the assemblage.

The Royall Lime

The final property investigated was the Royall Lime. This property has a rich history, and served as the British Consulate, was the location of a perfume factory giving the property its name (Royall Lyme), and also sported the town's first hotel, The Sea View, which burned in the 1940s. The current property owners, Muffet and Rich Arroll, are enthusiastic about collecting artifacts from the property, and the groundskeeper we spoke to informed us of a guest who surface collected systematically over the course of several annual visits, and dug holes close to the house seeking historic ceramics and glass. Because of these activities, we chose not to surface collect at this site.

The Royall Lime property is located directly north of The Little Boarding House, and is likewise located in the old town, across Bay Street from the harbour. It is fairly extensive, well maintained and landscaped. Like its neighbour, it possesses several levels; the southern edge slopes gracefully down to the street from the garage. Further north, in front of the main house complex, a retaining wall with a staircase separates the upper terrace from the lower yard where the Sea View once stood (Figure 8). We placed our primary transect running roughly east-west along the southern slope, parallel with the boundary fence (Figure 9). We also set up another transect crossing the hotel foundation, but as we encountered only more sand fill in the first test pit, we discontinued that attempt.

At the highest part of the slope, we encountered very deep deposits (over one meter) with a high concentration of historic glass. The soil became shallower as we descended the slope, towards the west. Perhaps unsurprisingly, this property contained high amounts of historic glass, though none of the sherds recovered seem to represent the bottles used to hold the perfume factory's final product. The Arrolls have collected some royall lyme perfume bottles from elsewhere on the property, and allowed us access to examples on display in the house for comparison.

From the second of the deepest shovel tests, we also recovered some bone fragments that may be a single tibia from a juvenile human. The shovel test also contained many other small bone fragments, some of which may be human, but others that are fish or non-human mammals. It is possible the remains are fill from an older landscaping event, drawn from some area other than the beach or highlands. They may also represent a midden or trash disposal area associated with the factory, as they contained an exceptional amount of glass fragments.

South Bar

We also had the opportunity to examine and record six 18th-century cannon located on the south-east point of Harbour Island that may be associated with the fort mentioned in the 18th-century records previously noted. The fort also appears on both early maps, but though the topography is suggestive, we could not find any evidence of remains in our investigation. The denseness of the thicket in the area made a more thorough search difficult.

The cannon, resting on a shallowly-buried rock path or walkway and oriented roughly in a straight line tracing the old harbour mouth, are a well-known local landmark. We spoke to a number of residents and recurring visitors who have personally examined the cannon, and were aware of their location and the associated walkway or platform. None reported finding any other artifacts in the area, and we did not uncover any either.

The cannons are set back from the shoreline on the coppice-covered hill, but roughly overlook the narrowest point of the harbour mouth formed by Harbour Island and Eleuthera. We photographed and recorded the dimensions of each piece, and excavated more extensively around Cannon 3 to uncover and map a section of the platform below (Figure 10). We also probed the area with the end of a survey flag to test the extent of the platform, and found that it ends just beyond the row of cannons in all directions. Because there are no associated artifacts, it is difficult to assess when the cannon were placed in their present position.

The preservation of the cannons varies greatly. C5 and C6, the two furthest from the road (and therefore further into the coppice) are in the best condition. These cannon are also less deeply buried than the others, and it is likely a combination of these factors (less accessible, better protected from the elements, less contact with the soil) that accounts for their condition. Both C5 and C6 have makers marks on their trunnions (a Z or N), and C5 is marked with an incised with the British Royal Navy's broad arrow above the first reinforce. None of the other cannons appear to be marked in any way, but these features may be obscured by corrosion.

Conclusion

Analysis of the artifacts recovered from this season is ongoing, and it is too early to draw conclusions relating to the nature of maritime communities. Ultimately, as part of my doctoral dissertation at Texas A&M University, I plan to compare the materials recovered to assemblages from other contemporaneous sites from the British colonial world to try and understand if, and how, maritime communities differed in their material culture. Such differences may relate to the relationship between identity, both of the community and its individual inhabitants, and the maritime environment. Although the assemblage collected from this season is large, further recovery is planned for summer 2010 in order to amass a more

robust sample from a wider area. This will lend support to any conclusions I am able to draw from this work.

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Notes

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