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KRISTIN ROMEY, EDITOR

THE INA ANNUAL 2007

A NEW BEGINNING

James P. DELGADO
President, Institute of Nautical Archaeology

Welcome to the first issue of the new *INA Annual*. This inaugural issue 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 of 2007. Subsequent issues will cover work conducted in 2008 and beyond.

In 2007, thanks to the generous support of INA directors, friends, and other supporters, including foundations and other grantors, and partnerships including INA's major support from Texas A&M University, as well as partnering societies, institutions and museums, seventeen archaeological projects took place in the United States, Canada, Bermuda, Cyprus, Turkey, Lebanon, Israel, Spain, Portugal and Japan. These projects ranged from field surveys, site assessments, excavations, and post-excavation analysis and conservation in the INA Bodrum Research Center in Bodrum, Turkey, in partnership with the Bodrum Museum of Underwater Archaeology.

Each year the Institute of Nautical Archaeology conducts one or more excavations on important shipwrecks that have the potential to answer key research questions. In 2007, Dr. Deborah Carlson of the Nautical Archaeology Program of the Department of Anthropology at Texas A&M University conducted the third excavation season on the first-century B.C. Roman period shipwreck at Kızılburun with its cargo of worked marble, including a monumental column's drums. Dr. Cemal Pulak of the Nautical Archaeology Program at Texas A&M University, and an INA Vice President, worked on his fifth and sixth shipwrecks at Yenikapi, the now landfilled Byzantine harbor of Constantinople and a veritable graveyard of more than 33 shipwrecks discovered during construction in amazingly good condition in present day Istanbul. Dr. Kevin Crisman of the Nautical Archaeology Program recovered nearly all of the remaining mechanical elements from *Heroine*, an 1838 steamboat sunk in the Red River in Oklahoma. A test excavation of Cartagena, Spain by research associates Juan Pinedo Reyes and Mark Polzer of the Texas A&M Nautical Archaeology Program revealed the remains of a Phoenician-era shipwreck of the sixth century B.C. at the Bajo de la Campana site, and paved the way for a full field season in 2008.

The institute's new website, www.inadiscover.com features all INA projects. Plans are underway for a more comprehensive web-based "Virtual Museum of Nautical Archaeology" in partnership with Texas A&M University and other partners as a key element of INA's strategic plan to deliver more detailed, in-depth scholarship and to augment scholarly content and make data more accessible.

On behalf of the Institute of Nautical Archaeology, we acknowledge the gracious support of our donors, sponsors and members, and we thank you for your support of INA.

2007 TURKISH COAST SURVEY

George F. BASS

Between 20 September and 7 October 2007, an INA survey team utilizing the ship *Virazon*, the catamaran *Millawanda*, and the submersible *Carolyn*, successfully completed searching the area between Foça and Çeşme where we had begun a survey in 2006. Although we lost a week prior to the starting date due to strong winds and high seas, we still ended the survey days earlier than scheduled simply because we had exhausted places to search.

Virazon is the 65–foot (20–meter) ex-U.S. Army T-boat I first took to Turkey in 1964 on loan from the U.S. Navy, but which INA purchased outright in 1988. It is outfitted with sleeping facilities for ten people, a double-lock recompression chamber, all necessary compressors and diving equipment, and more recently an air-conditioned computer room. *Carolyn* was designed specifically for INA by the Seamagine Hydrospace Corporation of Claremont, California, to cruise with two people in a clear acrylic sphere at a depth of 150 feet (46 meters); buoyant, the submersible is kept at depth by a constantly turning propeller in a central well, which means it will float to the surface in case of battery failure. The 45-foot (14-meter) *Millawanda* was designed by Merih Karabağ, a veteran of INA scuba-diving surveys, and built in Istanbul and Bodrum to transport, launch, and retrieve *Carolyn*.

Diving for three to four hours at a time in *Carolyn*, we thoroughly searched the treacherous reefs just

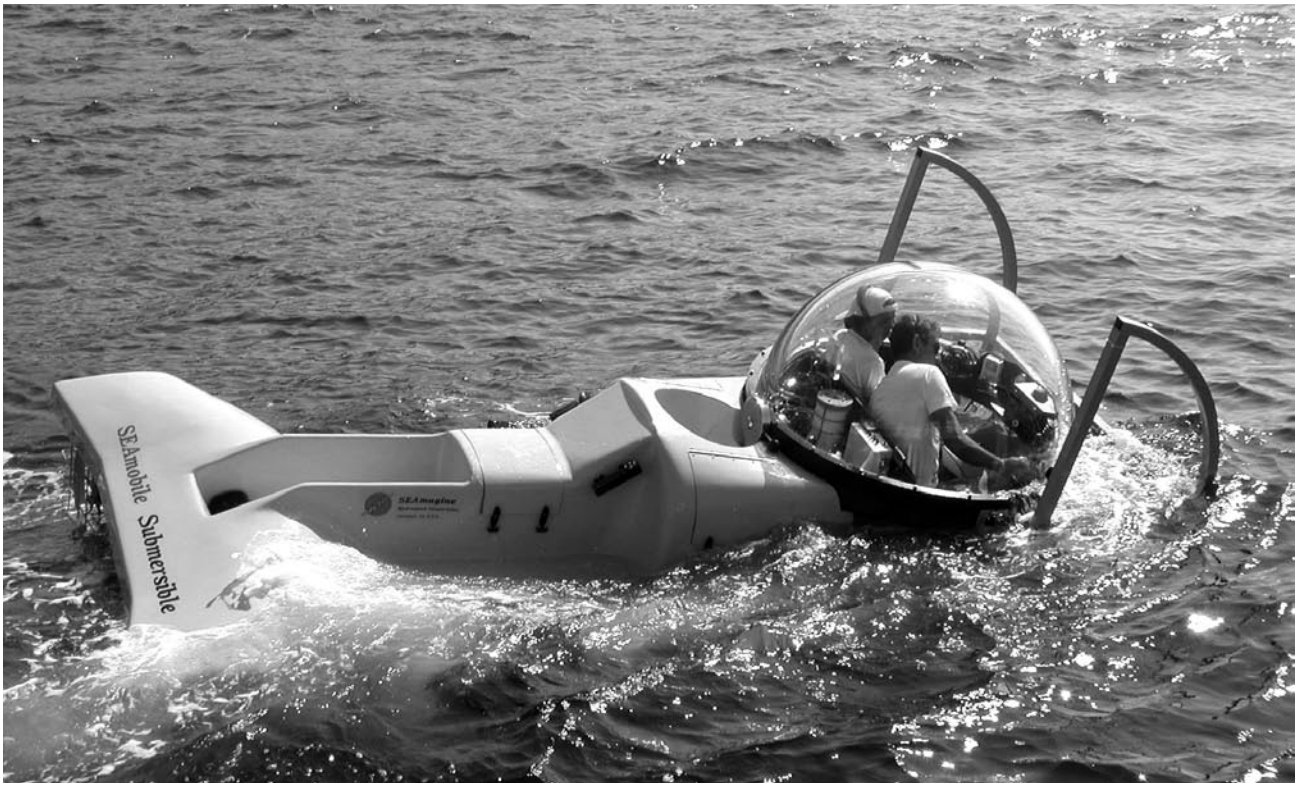

Fig. 1. *The submersible* Carolyn *descending during the 2007 Turkish Coast Survey (all images courtesy INA)*

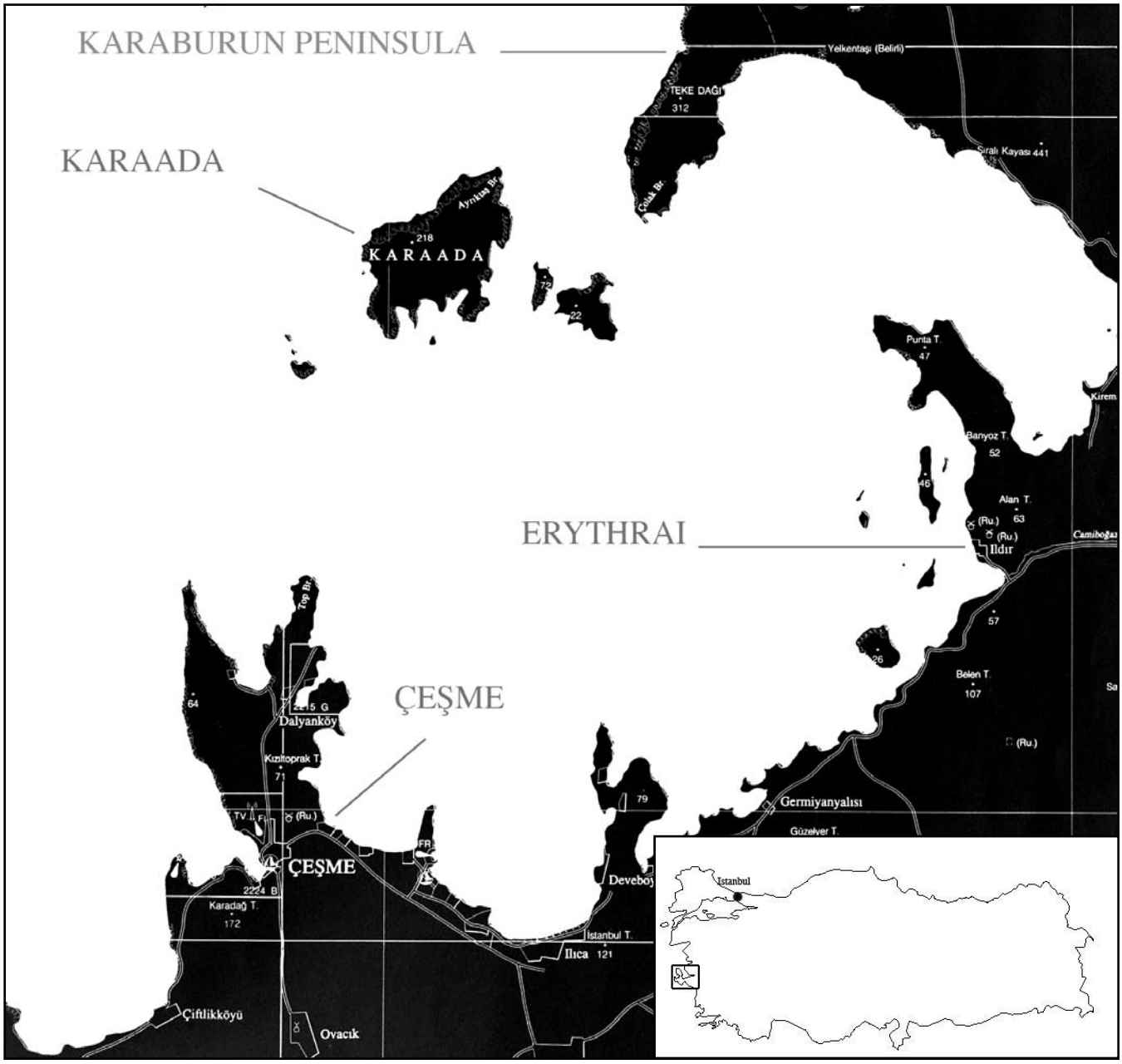

Fig. 2. *The 2007 Tukish Coast Survey took place between Çeşme and the Karaburun Peninsula.*

outside the entrance to Çeşme, especially to the north; the islands north of Çeşme and Dalyan; the islands and reefs near Ildır (ancient Erythrai); and the west side of the Karaburun Peninsula to its northern tip, where all diving is forbidden, perhaps for military reasons.

Although we frequently saw scatters of sherds, we located only two certain wrecks:

1. On September 25, just off Karaada's Ayrıktaş Burnu, *Carolyn* pilot Feyyaz Subay and observer Orkan Köyağasıoğlu spotted Byzantine amphoras and an iron anchor at a depth of 125 feet (38 meters). The wreck seems to be from between the fourth and sixth centuries A.D. Lying in sand it may preserve hull remains as well as other finds.

2. On October 6, off Kiraz Burnu, not far from Ildır, *Carolyn* pilot Orkan Köyağasıoğlu and commissioner Sinem Özongan spotted a wreck on a slope between 110 and 130 feet deep (33.5–40 meters). Two digital photographs e-mailed from *Virazon* to Mark Lawall at the

Figs. 3 and 4. *Byzantine amphorae, left, off Karaada's Ayrıktaş Burnu; an amphora belonging to a mid-3rd-century-B.C. shipwreck near the ancient site of Erythrai, right; all photographed from the submersible* Carolyn *during the 2007 survey*

University of Manitoba brought an instant identification: "Wreck 2 is roughly mid-third-century. B.C. with the complete amphora being from central Ionia, roughly the area between Ephesos and Miletos; the upper amphora part could be from the area of Erythrai." Lawall was unaware that the find spot is within sight of ancient Erythrai. The amphoras lie in pockets of sand between rocks, meaning that there are probably not substantial hull remains, but the site could be worth a summer's excavation.

INA has on file exact GPS coordinates for both wrecks, but does not publish these.◆

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The staff, all living on *Virazon*, were George F. Bass, director; Feyyaz Subay, *Virazon* captain, *Carolyn* pilot, diver, and archaeologist; Claude Duthuit, master diver; Zafer Gül, *Virazon* engineer, *Carolyn* pilot, and diver; Orkan Köyağasıoğlu, archaeologist, *Carolyn* pilot, and diver; Recep Kendirci, Ankara University archaeology student and diver; Bayram Koşar, *Millawanda* captain and diver; Levent Çimen, master seaman, archaeologist, and diver; Bülent Demirbağ, cook; and Ali Öncel, *Virazon* oiler. Sinem Özongan, archaeologist and diver, represented the Turkish Ministry of Culture.

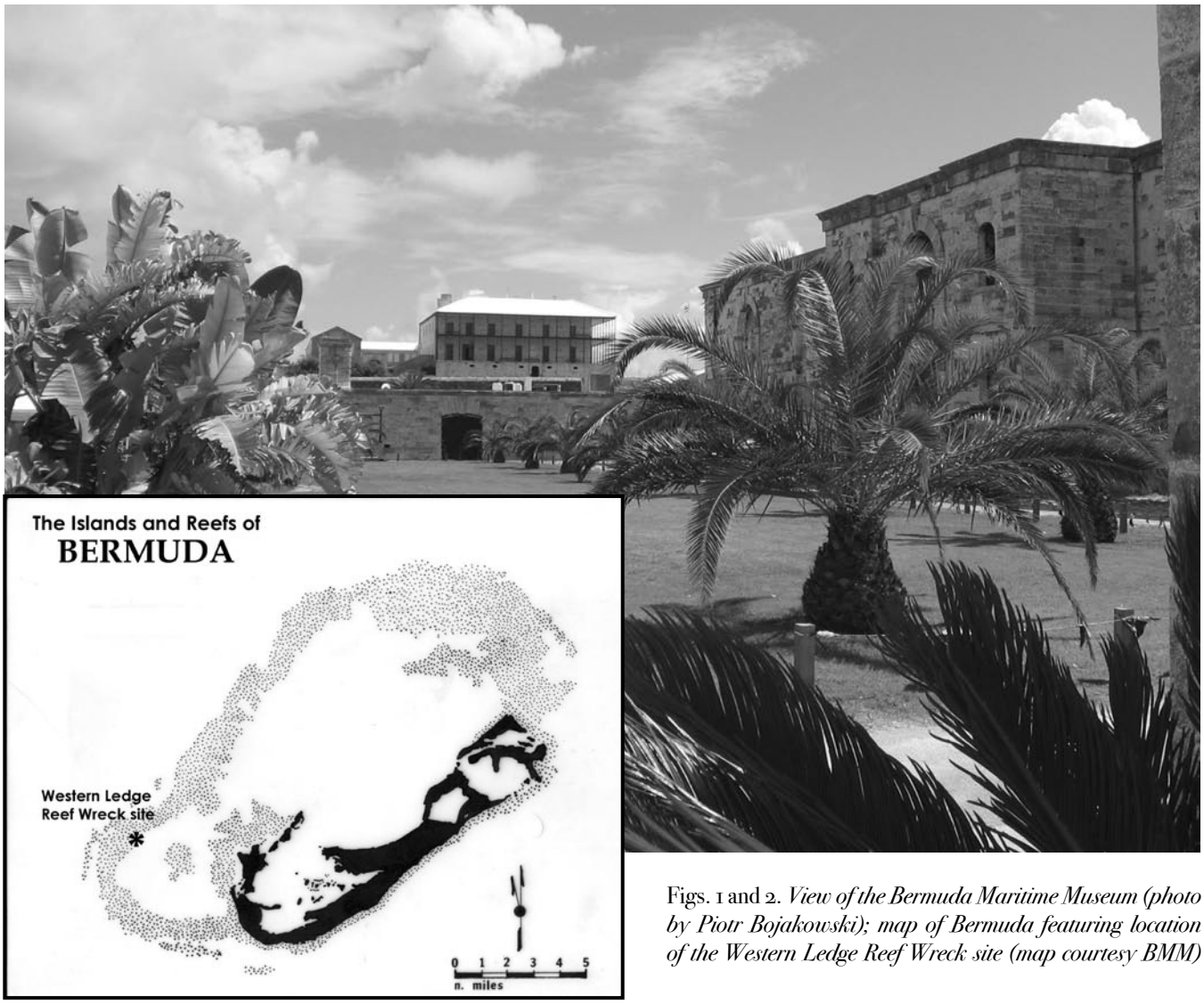
Figs. 5 and 6. *A view from the* Carolyn *as it approaches the* Millawanda*; the* Virazon

THE WESTERN LEDGE REEF WRECK

Research on the Reconstruction of the 16th-centuty Iberian Wreck from Bermuda

Piotr BOJAKOWSKI

Following INA's long established tradition of researching ships of discovery and exploration, Piotr Bojakowski and Katie Custer traveled to Bermuda to analyze the ship timbers and study the construction methods of the Western Ledge Reef Wreck (IMHA 3), also known as *Santa Lucia*. Although not a new discovery, being excavated between 1989 and 1991 (Watts, 1993), this wreck is believed to be one of the best preserved Caribbean examples of the late sixteenth-century Iberian shipbuilding. Currently, the ship remains and artifacts are under the curatorship of Edward Harris at the Bermuda Maritime Museum (BMM) where the INA research team stayed and worked during the summer of 2007 (fig. 1).



Figs. 1 and 2. *View of the Bermuda Maritime Museum (photo by Piotr Bojakowski); map of Bermuda featuring location of the Western Ledge Reef Wreck site (map courtesy BMM)*

Project Background

The wreck, which is believed to be the Spanish dispatch vessel *Santa Lucia*, was originally discovered in 1964. The remains were located among the treacherous Bermuda's western reefs, north-east of the Chubb Heads navigational beacon (five miles/eight kilometers west of Bermuda) in about 31 feet (9.4 meters) of water (fig. 2). Soon after the initial discovery, the three divers who found the remains were joined by Brian Malpas and Donald Canton and formed an association to salvage the site. This salvage operation was intermittently carried out for over 25 years producing several small and large artillery pieces, anchors, Iberian and New World ceramics, a ship's bell, a jade amulet, and numerous other artifacts. Coincidently, while conducting research in Bermuda, a student from the Nautical Archaeology Program (NAP) at Texas A&M University, Holly Holland, learned about this site. In 1988, she was hired by Bermuda Maritime Museum to relocate the shipwreck and conduct a preliminary survey (F. Hocker, personal communication). During the midsummer of 1989, an underwater archaeological team from East Carolina University (ECU) took over the project. An agreement was reached and the ECU team, under the direction of Gordon Watts, began systematic and scientific excavations of the wreck (fig. 3). This investigation culminated not only in the full recovery of the hull remains and associated artifacts, but also in the recording of all the hull timbers during the fall of 1991 (Morris, 1993; Watts, 1993).

Although the metal fasteners were completely corroded, thus almost non-existent, the hull remains were still in good shape. Once the massive keelson was detached from the structure and lifted to the surface, the remaining structural elements could be freed. These remains included curiously shaped six mast step buttresses, limber boards and ceiling planks, as well as frames and first futtocks. The planking was disassembled by working from outboard towards the center, and the garboards were extracted from the keel by cutting the planks in several places. Finally, in order to make the keel more manageable for lifting, it too was cut into three pieces. Once the ship timbers reached the BMM facilities, they were photographed, drawn on mylar, and placed in three storage tanks for desalinization. Shortly thereafter, further progress of the project was delayed and then completely discontinued, thus the scientific analysis of the hull as well as the proper conservation of the timbers has been unfinished (Morris, 1993; Watts, 1993).

Figs. 3 and 4. *Original excavations (photo courtesy of BMM); the author compares 1:1 scale mylar drawing to the original ship timber (photo by Katie Custer).*

2007 Season

In an effort to expand our understanding of Iberian seafaring technology and acquire a compelling topic for a doctoral dissertation, the author received the permission of Dr. Harris of the BMM and Dr. Watts to conduct the final analysis of the *Santa Lucia* hull remains. Soon after the project was approved by the INA Archaeological Committee, the author was joined by a fellow nautical student Katie Custer and visited the BMM to assess the excavation records stored in the museum's archives. During the first phase of the project, we reviewed and copied all of the excavation materials ranging from the first survey records from the 1988 Texas A&M excavation, to the final excavation season and post-excavation timber recording conducted by ECU, to the artifact conservation records. This included notes, reports, newspaper articles, personal and official correspondence, dive-logs, sketches, and drawings. We scanned numerous field photographs from the excavations and post-excavation recording. We also created a provisional inventory of more than 130 individual timber drawings on mylar. To facilitate our research, Dr. Harris, executive director of the BMM, agreed to a temporary loan of the data, which permitted the author to transport the original and collated materials back to College Station, Texas, for further study. Dr. Harris also inquired about potential assistance of the Center for Maritime Archaeology and Conservation (CMAC) at Texas A&M University in the stabilization and conservation of the *Santa Lucia*'s waterlogged timbers.

Fig. 5. *The author takes pin measurements in the museum's storage tanks (photo by Katie Custer)*

During the second phase of the project, we examined 1:1-scale mylar drawings by comparing them to the original timbers (fig. 4). After meticulously testing a majority of the drawings by this method, we established that the quality and the level of accuracy were uniformly high. Next, we began assessing the physical condition of the timbers stored in concrete wet storage tanks arranged in a three-tier cascade system. Upon inspection, we discovered that the timbers stored in the two lower tanks visually appeared to be in good condition and were completely immersed in water. While checking the upper third tank, however, we found that the water level had dropped and barely covered the bottom of the timbers. Where the timbers had been exposed, all of the outer surfaces were dry and highly deteriorated. To secure the data from the latter tank, we made drawings of representative desiccated timbers on acetate, created a photo-mosaic of the tank, and took wood samples for further analysis.

To evaluate the level of external timber deterioration, we took numerous pin tests on timbers from all the tanks using a two-millimeter stainless steel pin (fig. 5). Even though this is a subjective test, the pin method is a helpful and quick assessment method for any waterlogged wood. Depending on the timber surface, the pin measurements stayed on average between 10–11.6 millimeters. We also assessed average shrinkage and distortion of the timbers to fall within 8 percent.

To evaluate the internal condition of the timbers, we used an incremental wood borer and took two core samples. The first sample came from the center of Frame Three, while the second sample came from the starboard face of the keelson. Both samples were securely packed and taken for further tests and chemical analysis at CMAC. This portion of the project constituted a crucial element of the initial evaluation of the external and internal conditions of the timbers, an evaluation which will determine future conservation methodology for this remarkable vessel.

Preliminary Data

Unlike other, much less preserved, sixteenth-century Caribbean and Gulf of Mexico parallels such as the Highborn Cay Wreck, the Molasses Reef Wreck, or the San Esteban Wreck, the level of timber and artifact preservation from the *Santa Lucia* is phenomenal (Arnold, 1978; Keith, 1985; Oertling and Thomas, 1989; Oertling, 1989). Except for the missing bow section, the remains comprise almost

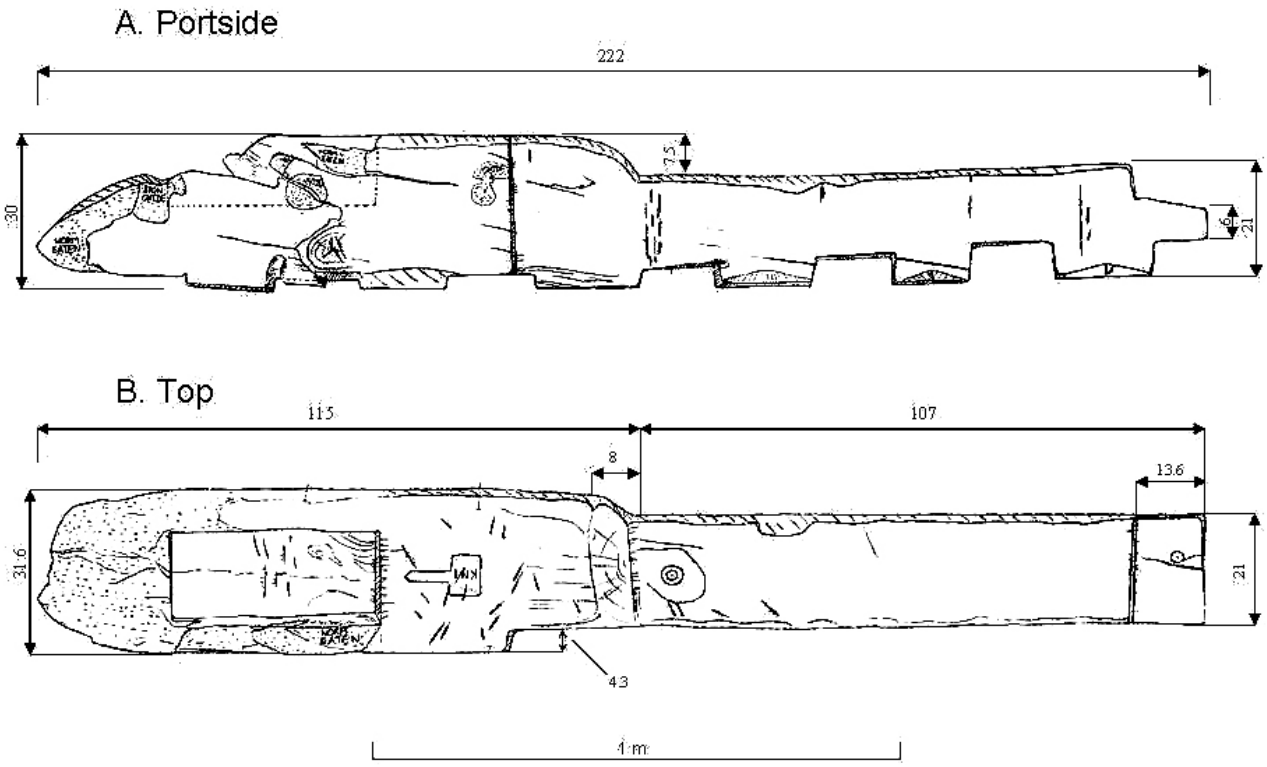


Fig. 6. *General dimensions of the keelson/mast step (drawing KN 1/1); all measurements in centimeters (drawing courtesy of BMM, modified by Piotr Bojakowski)*

the entire bottom of the vessel including the keel, keelson, a mast step and six buttresses, 14 floor timbers including seven with characteristic dove-tail mortise and tenon joints, 22 first futtocks, bottom planks, ceiling planks, most of the lower stern assembly, and some loose timber fragments.

Out of all the preserved ship timbers, the *Santa Lucia*'s keelson is possibly one of the most interesting and typologically Iberian pieces. Since it incorporates the mast step in its expanded central section, this assembly combines two important functions within one structural element. It provides great internal longitudinal strength while at the same time it gives support for the heel of the main mast. Although the exact wood species awaits more specific identification, it is certain that the preserved portion of the keelson was fashioned from a single oak log. At present, the wood is identified only as a generic European oak, *Quercus* sp.

The total preserved length of the keelson/mast step assembly, as illustrated in fig. 6, is 2.22 meters. Apart from the worm-eaten forward portion, the assembly constitutes nearly a complete mast step box and an entire aft section of the keelson proper. Although the fore section of the keelson had perished prior to the original excavations, careful observations of the pressure marks on the upper surfaces of at least two floor timbers forward of the master couple as well as remnants of the fasteners reveal that it was once present. Currently, the forward most end of the preserved assembly corresponds with the location of the master couple and it terminates over the sixth floor timber aft. After being positioned, the keelson/mast step assembly was fastened through the floor timbers to the keel with two round iron bolts, and to a floor timber with a square nail.

The keelson curves slightly up towards the stern, a pattern which corresponds with the rising of the floor timbers, and its underside is notched to fit over the corresponding frames. The depths of these notches increase sequentially; with the shallowest matching the locations of the master couple and the first floor timber, and the deepest located at the extremities. The aft end of the keelson bears a striking resemblance to a horizontal scarf. The presence of such scarf, as well as the surprisingly short length of the keelson/mast step assembly, could potentially suggest a composite construction in which the keelson was made out of joined together timbers. It is also quite likely that the keelson assembly originally extended forward beyond the exist-

ing mast step box. The existence of this inferential section is confirmed by the presence of distinct pressure marks on at least two floor timbers forward of the master couple, and it parallels the keelsons from the other Iberian shipwrecks, notably the Angra D (Garcia and Monteiro, 1998).

Although none of the components were preserved, the keelson shows evidence of at least one bilge pump. Its seating was carved on the portside of the mast step box directly aft of the mast mortise. Contrary to the semi-circular sumps known for other sixteenth-century Iberian wrecks, a cut away section of the *Santa Lucia* keelson resembles a square step (Oertling, 1996).

The mast step box is laterally supported by six wedge-shaped buttresses; three on the portside and three on the starboard. Their roughly triangular shapes are disrupted along the bottom surface with a distinct step. For the first 19–24 centimeters inboard, the bottom is flat and the buttresses rest directly on the floor timbers. Then, they have a four centimeter-deep rebate after which their remaining undersides rest over the first ceiling strake (fig. 8). It is important to note that the arrangement between the buttresses and the first ceiling plank, a plank which perfectly fits into the notches cut in the undersides of the buttresses, is unparalleled with any other such arrangement known from the sixteenth-century Iberian-Atlantic shipwrecks. Finally, the spaces between the buttresses were originally covered with thin longitudinal boards; two on the portside and two on the starboard.

Fig. 7. *Model of the site of the Western Ledge Reef Wreck (courtesy of BMM)*

Analogous to the galleon *San Juan*, it appears that the *Santa Lucia* keelson/mast step assembly was most likely manufactured using broad axes and finished off with adzes (Loewen, 1998). Consecutive broad axe marks are especially prominent on the bottom and side surfaces. Similarly, the top surface of the mast step box and the inside of the mast mortise predominantly show adze marks. The edges along the top surfaces of the assembly are beveled, which was a standard shipbuilding technique. The bottom surface is fashioned with the characteristic notches seamlessly fitting over the corresponding floor timbers. Such an arrangement between notches and floors helped not only to anchor the keelson in place, but also facilitated an equal distribution of all of the stresses from the main mast and the rigging onto the floors. Additionally, the outboard edges of the spacers between notches show an interesting reverse "triangular-" or "chevron-shaped" bevel, which could have reduced potential wood splitting as well as facilitated the access to the bilge for cleaning.

Conclusion

The first season of the Western Ledge Reef Wreck Project (*Santa Lucia*) was an overwhelming success. Although the author is still in a process of reviewing, properly cataloging, and analyzing the data the team brought back from Bermuda, the largest portion of the work is completed. This portion included scanning all of the 130 1:1-scale timber drawings into high resolution TIFFs, scanning more than 600 slides, as well as converting all of the paper records into PDF format. The team also began an exciting process of analyzing the hull remains for the reconstruction of this important Iberian shipwreck already making some interesting discoveries. For the next and final field season, Bojakowski and Custer will return to Bermuda to conduct archival research on this wreck and review a large collection of historic documents at the BMM, Bermuda Archives, and Bermuda National Library. Finally, we also would like to review all

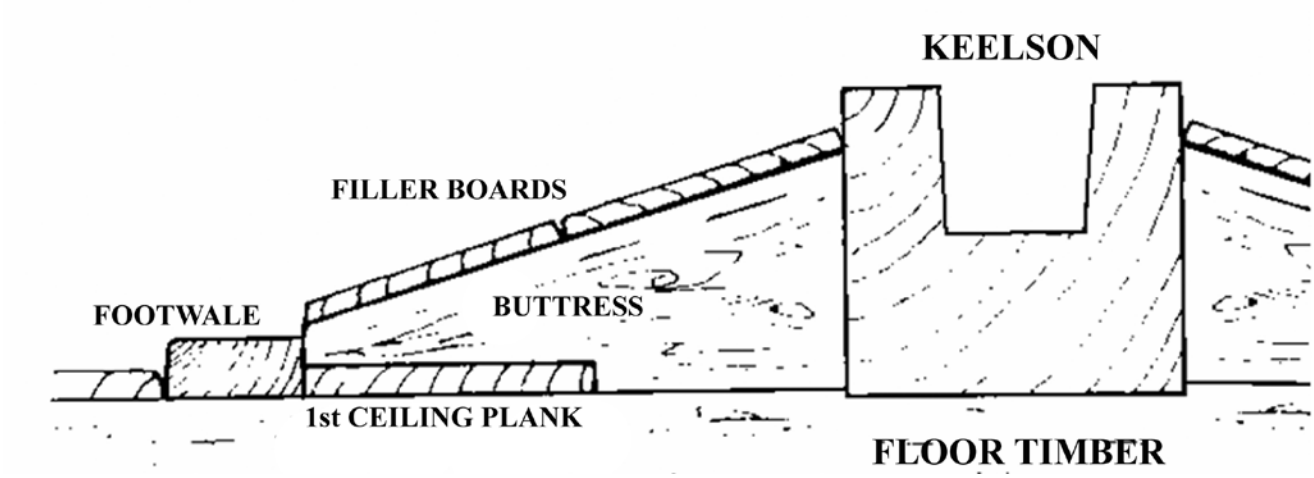


Fig. 8. *Schematic arrangement between keelson, buttress, first ceiling plank, and stringer (footwale) (drawing by author)*

of the artifacts from this wreck, concentrating specifically on the rigging elements, ordinance, and anchors.◆

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References

Arnold, J. B. I., 1978. *The Nautical Archaeology of Padre Island: The Spanish Shipwrecks of 15.* Academic Press, New York.

Loewen, B., The Red Bay Vessel: An example of a 16th-century Biscayan ship. *Itsas Memoria. Revista de Estudios Maritimos del Pais Vasco, 2*, Untiz Museoa-Museo Naval, Donostia-San Sebastian, 1998, 193–199.

Garcia C. and Monteiro P., The excavation and dismantling of Angra D, a probable Iberian seagoing ship, Angra Bay, Terceira Island, Azores, Portugal: Preliminary Assessment. *International Symposium on Archaeology of Medieval and Modern Ships of Iberian-Atlantic Tradition*, Lisbon, 1998, 431–447.

Keith, D.H., 1985. Analysis of Hull Remains, Ballast, and Artifact Distribution of a 16th Century Shipwreck, Molasses Reef, British West Indies. *Journal of Field Archaeology* 12:4, 411–424.

Morris, J. W., 1993. The Preliminary Analysis of the 16th Century Remains Recovered from the Western Ledge Reef Wreck, Bermuda. *Bermuda Journal of Archaeology and Maritime History* 5, 58–69.

Oertling, T.J., 1989. The Highborn Cay Wreck: The 1986 Field Season. *IJNA* 18:3, 244–253.

_____, 1996. *Ships' Bilge Pumps: A History of Their Development, 1500–1900*. Texas A&M University Press, College.

Oertling, T.J. and Thomas, J., 1989. Molasses Reef Wreck Hull Analysis: Final report. *IJNA* 18:3, 229–243.

Watts, G. P., 1993. Investigation of the 16th Century Shipwreck on Western Ledge Reef: 1988-1991. *Bermuda Journal of Archaeology and Maritime History* 5, 34–57.

Watts, G. P., Broadwater, J., Morris, J. W., and Franklin, M., 1993. A Preliminary Description of the Excavation, Timber Recording, Hull Construction, and Cultural Material Analysis of a Sixteenth-Century Wrecked on Western Ledge Reef, Bermuda. *IJNA* 22:2, 103–124.

FINDS FROM HISPALIS

A Byzantine Anchor and Medieval Small Boat From the Ancient Harbor of Seville

Carlos CABRERA TEJEDOR

Of the few known examples of Byzantine shipbuilding, the most important ones are located in eastern Mediterranean. Therefore, report of a Byzantine-style ship found on the shores of the Guadalquivir River in Seville, Spain, seemed quite an unusual and important discovery. That was the main reason why, thanks to the support of the Institute of Nautical Archaeology, I traveled to Seville in June 2007 to inspect the remains of a wooden ship and an iron anchor that was apparently built in the Byzantine Empire in the sixth century.

In 1981, during the preliminary construction works of Seville's subway at a public square, Plaza Nueva, abundant archaeological remains from the Iberian to the Islamic periods were found. Among these discoveries were the remains of a small ship found in the substrate at a depth of eleven meters. Unfortunately, the cofferdam supporting the walls of one of the access pits to the subway tunnels had split the small ship into two pieces, destroying the ship's starboard side as well as the aft part of the vessel. The remaining ship's structures, such as a part of the keel, several frames

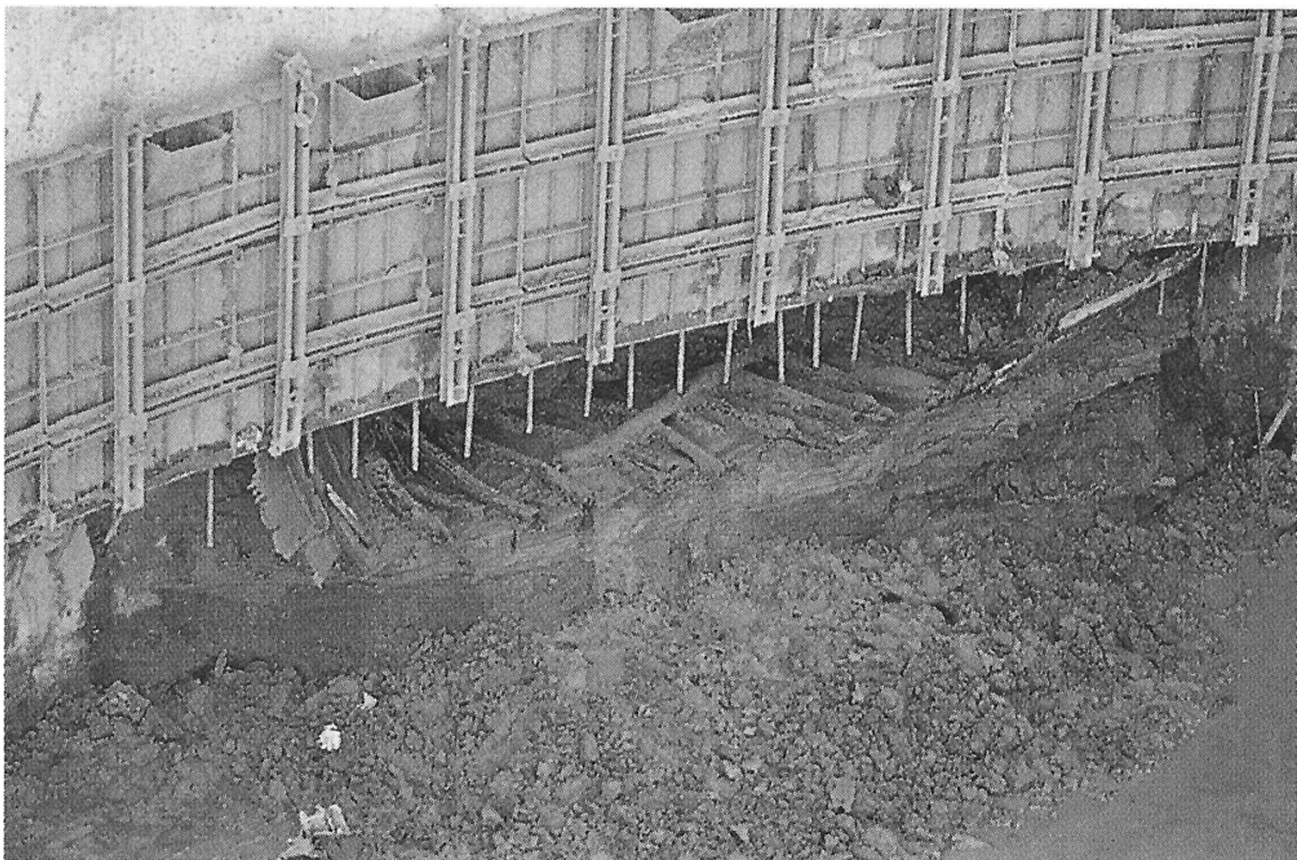


Fig. 1. *The ship's remains in the moment of the discovery in the substrate of the Plaza Nueva of Seville (photo courtesy Seville Archaeological Museum)*

Fig. 2. *A map of the Guadalquivir river basin and the location of Seville in southwestern Spain*

and planks, the keelson and the stempost were recovered, but they had been severely damaged from earlier bulldozer excavation of the access pit. Four meters underneath the ship, at 15 meters of depth, another item was found: an iron anchor surrounded by three marble column shafts and Iberian and Dressell 8, 11, 17, 19, 20 amphora sherds (fig. 1).

Although the wooden remains of the small boat were deposited in the Seville Archaeological Museum, they were never seriously studied. The first bibliographical reference of them—and therefore of the ship—appeared seven years after the discovery. This publication briefly described and cataloged the discovery as "Seville Ship" and identified the wooden remains of the ship as Byzantine. The support for this chronological hypothesis was based solely on the relation of the ship remains to the anchor found underneath the vessel, which has Byzantine typological characteristics such as a cruciform shape. According to chronicles and historical accounts, the Byzantine forces under Justinian I controlled Seville during three different periods: from 552 to 567, from 580 to 583, and in 610. (The veracity of the last date, however, is unclear and still in debate for some scholars.) Thus, the Byzantine occupation of Seville served to date the discovery of the vessel and anchor back to the second half of the sixth century A.D.

Paleographical Background

The geomorphology of the city of Seville has changed with the passing of time. Scholars place the origin of the settlement on a small hill surrounded and connected with the salt-water lagoons and the Baetis River, the ancient Roman name for the Guadalquivir. In the second half of the eighth century B.C., the Phoenicians either established a colony or started to interact with an already established Iberian settlement. The Phoenician name for this settlement was Spal. In the first century B.C., under orders from Julius Caesar, a Roman colony was established at the same location: Hispalis. This well-documented Roman colony was an important harbor for the Baetica re-

gion. The hill area where the colony was established was surrounded by several riverbeds until the thirteenth century. The number of original riverbeds and the changes that occurred in the thirteenth century are still debated by scholars; however, it seems clear that at least one riverbed did existed until the thirteenth century (fig. 3). This minor riverbed connected the main riverbed of the Guadalquivir from north to south and was located in the middle of today's Seville downtown. It was in this riverbed where the original harbor of Spal, and later Hispalis, Ishbiliya (the name of the city when it was under Muslim rule in the medieval period), and, eventually, Seville, was located.

The location of the original harbor is the reason why maritime remains, as a ship, an anchor, and amphora sherds, were recovered from the substrate of the today's Seville downtown. Besides the finds described in this article, at least two more shipwreck remains appeared in the second half of the twentieth century, specifically in the area where the lost riverbed was located. Unfortunately, it appears that there was a lack of archaeological intervention at the time of their discovery, and very little information has been recorded about them.

The Anchor

Unlike the boat remains, the anchor was studied in detail by a Spanish scholar. Currently on display at the Archaeological Museum of Seville, the anchor undoubtedly belongs to the Byzantine tradition due its shape and characteristics (fig. 4). It was made using the forged-welded technique with several iron pieces in a cruciform shape. The longitudinal axe of the two arms joined together to form a single straight line which is perpendicular to the longitudinal axis of the shank, thereby forming a cross. The measurements of the anchor remains are ca. 172 centimeters tall by ca. 83 centimeters wide.

The anchor is partially preserved and, before its discovery, had lost the aft part of the shank including the ring and the elliptical aperture for a moveable stock. The anchor also had lost the moveable stock, half of one of the arms and the projecting crown. Taking into account the missing parts, the reconstructed overall dimensions of the anchor would be ca. 220 by. 130 centimeters. The shank has a cylindrical section, being wider near its juncture with the arms. The arms are 40 centimeters in length in a rectangular section without counting the fluke. The completely preserved arm turns up at its end with an inclination of 45° while simultaneously tapering down in thickness to a flat edge. As the arm turns up, it also narrows down to about three-quarters of its maximum width and then widen again to form the flat fluke as it turns up. The fluke of 20 centimeters in length is poorly developed, being no wider than the main body of the arms. The arm does not posses what might properly called a palm, since it does not have a flat upper surface.

The dimensions of the anchor give us a hint about the size of the vessel which carried and lost it. Considering the dimensions of the anchor, we may state that

Fig. 3. *The reconstructed position of the lost riverbed of the Guadalquivir River in Seville (image supplied by Carlos Cabrera Tejedor)*

the vessel may have been fairly large. A journal hypothesizes about the possibility of the ship being a dromon, yet this idea appears to be supported only by the fact that these types of vessels were used by the Byzantine Empire. Taking into account the little evidence available, nothing more can be said except that it almost certainly dates back to the second half of the sixth century.

The Seville anchor is similar to those found on the seventh-century A.D. Yassı Ada shipwreck. It is particularly comparable with anchor number seven, since both possess practically identical overall dimensions and morphology. Perhaps the vessel that lost this anchor in Seville had similar characteristics to the shipwreck that sank in Turkish waters.

The Ship

Following the discovery of the Seville Ship in 1981, the wooden remains of the vessel were taken to the Seville Archaeological Museum, where preventive conservation measures were taken. According to current museum curator Diego Oliva, museum staff solicited the advice of a conservator from the National Archaeology Museum of Madrid, who recommended that the vessel remains be buried in a large coffer of sand. The sand-filled coffer and the wooden remains contained therein were kept wet through the process of watering the sand of the with tap water on a daily basis. Unfortunately, at some point during the 1980s, the watering process was discontinued. In the late 1990s the wooden remains were extracted from the coffer and placed in twelve PVC boxes where I subsequently found them in desiccated and in a state of extremely poor preservation. The boxes, stored in the basement of the museum, are labeled with the approximate area of the ship—aft or forward—that their wooden contents were recovered from.

The timber remains are not very large. Based on their size, my first impression was that these remains were likely to belong to a small boat rather than a ship. It stands to the reason that an anchor of almost more than two meters in length could not belong to a small boat. Therefore, I realized that the boat remains could not been related to the anchor.

While inspecting the remains, my objective was to identify any typological shipbuilding construction features that could relate the remains to Byzantine shipbuilding traditions from the sixth century. Thus, planks, frames, joints, nails, etc. were examined and documented. Due to the short of length of my visit—one day—I documented the timber remains by taking photos with a digital camera, making measurements, and sketching some details. The overall results of the brief survey are as follows:

The average thickness of the planking is smaller than two centimeters. This thickness does not provide enough space in order to create mortises for tenon placement. In fact, after inspecting all the remains I could not find any trace of mortises or tenons. The single joinery method found in the remains was iron fastenings. Iron nails were found that have a square body section with a circular rounded head. The average length of the nails ranges from ca. 8–15 centimeters (fig. 5). The thickness of the planking and the size and length of the nails also supports the hypothesis that the remains probably belong to a small size boat.

Among the timbers, several pieces were identified as remains of the boat's frames. These frames were square in section and around 10 centimeters thick. The frames are broken in pieces and none is completely preserved. Therefore, is difficult to know the original length of them, but taking in consideration the size of the fragments—no bigger than 50 centimeters each—I estimated that the frames probably were not bigger than two meters at the amidships of the boat. In one of the original photos from the salvage, at least seven evenly distributed frames appeared from the stem to amidships (fig. 6). Therefore, the original total number of frames were more than seven and probably less than twenty. The remains of the frames have two centimeter-square limber holes to permit water to freely move in the bilge (fig. 7). It appears that each frame originally had from two to four limber holes.

Some heavier timbers seem to be the preserved remains of the keel, keelson, and stempost. These fragmented remains are very warped; therefore, it is extremely difficult to identify them properly. The keel appears to have had an inverted trapezoid section with an exterior protrusion. The inner part of the keel is no wider than 10 centimeters and the exterior protruding part of

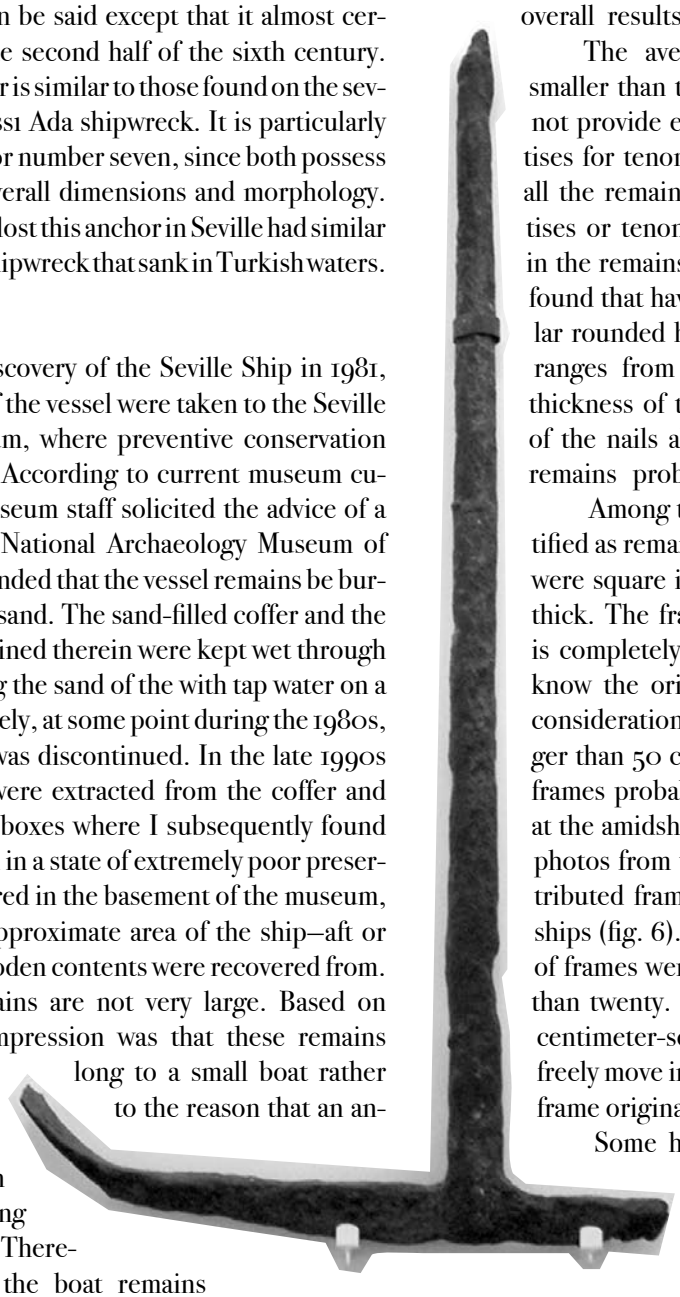


Fig. 4. *The sixth-century Byzantine anchor found underneath the ship; currently on display at the Seville Archaeological Museum (photo by Carlos Cabrera Tejedor)*

the keel is around 2 by 1.5 centimeters. About the keelson and the stempost, beside the information from the photos of the salvage, it is difficult to say anything in their regard due to their poor preservation status; they are timbers not wider than 20 centimeters with a square or trapezoidal section.

The planks were nailed to the frames from the exterior to the interior of the hull. The planks were also nailed to the keel and stempost using the same method. Frames were nailed to the keel and the keelson was nailed on top of the frames. All of these details suggest that the skeleton-first construction procedure with carvel planking method was employed to build this small boat.

The size of the wooden remains, the lack of mortises and tenons, and the presence of iron nails suggest that the Seville Boat was built in a period later than the sixth century A.D. and, therefore, belonged to a shipbuilding tradition different from the Byzantine. The boat must belong to a period earlier than the thirteenth century A.D., however, since the location where the remains were found, the Plaza Nueva, was later the site of the Convent of San Francisco. This convent was built in 1258 and destroyed by a fire in 1810. In 1840, the ruins of the convent were demolished and the public square was built. Therefore, the small boat probably belongs to the medieval period. Perhaps the boat belongs to the period between 711 and 1090 A.D. when Ishbiliya (Seville) was under Muslim rule.

After the inspection of the remains, I had an interview with museum director Fernando Fernández Gómez. Fernández was

Figs. 5 and 6. *Original photo from the salvage excavation of the Seville Ship—which is bisected by a cofferdam built to shore up a construction access pit—in which at least seven frames appear (photo courtesy Seville Archaeological Museum); three nails from the remains of the boat (photo by Carlos Cabrera Tejedor)*

the archaeologist who was in charge of salvage excavations at the time of the discovery of the Seville Ship, and he supervised the recovery of the boat remains in 1981.

He described the different archaeological levels that the excavation discovered, confirming how the subway works split the boat's remains with the cofferdam. The boat and the anchor remains were found at different archaeological levels, he reported, with the former found at 11 meters from the surface and the latter found four meters underneath the boat at 15 meters from the surface.

Fernández also described that the boat remains were no bigger than 10 meters in length and looked like a small fishing boat. In addition, he confirmed the scarcity of published data on the ship.

The boat was found in an archaeological level in where medieval (Islamic) pottery sherds were found, and medieval sherds surrounded the boat remains. This fact supports the hypothesis that the remains kept in the basement of the museum could belong to a medieval small boat built according to the Islamic shipbuilding tradition. As mentioned above, the anchor was found four meters underneath the boat, at 15 meters from the surface and in a different archaeological level than the boat.

Finally, underneath the archaeological level where the anchor was found, Roman archaeological material appeared at ca. 18 meters of depth. Therefore, the archaeological level where the anchor was found—that is, between medieval and Roman remains—supports the dating of the anchor back to the late Roman medieval period when the Byzantine domination of Seville took place.

Therefore, I suggest that the anchor and boat found in Seville in 1981 are not related. The anchor is clearly Byzantine, probably from the second half of the sixth century and belonging to a relatively large vessel. The remains of the vessel are of a small fishing boat that probably belongs to a later medieval period, perhaps the Islamic period between 711 and 1090 A.D. Even though the boat remains do not belong to the Byzantine period and culture, they are still important for a better understanding of the history of shipbuilding. Little information regarding Islamic shipbuilding is known. Therefore, a detailed study of these timber remains would result in interesting and productive research. Besides the historical and archaeological information that we could obtain from these remains, the conservation of the timbers itself constitutes a challenge. The union of these two challenges—conservation and timber study—is an endeavor that should be pursued in the near future.◆

Fig. 7. *One of the frame fragments featuring a limber hole and an iron nail in the upper right (photo by Carlos Cabrera Tejedor)*

Acknowledgments

I want to express my gratitude to the Institute of Nautical Archaeology and Kevin Crisman, head of the Nautical Archaeology Program at Texas A&M University, for generously supporting this research. I also want to express my gratefulness to the research staff of the Archaeological Museum of Seville: Fernando Fernández Gómez, director, for his help, comments and collaboration; and Diego Oliva, curator, for his assistance and comments.

LEAVING NO STONE UNTURNED

The 2007 Excavation Season at Kızılburun, Turkey

Deborah N. CARLSON and Carrie E. ATKINS

For ten weeks during the summer of 2007, a team of undergraduate and graduate students, visiting archaeologists, and staff of INA's Bodrum Research Center continued the excavation of a shipwrecked marble carrier at Kızılburun, Turkey (fig. 1). The 2007 Kızılburun team was made up of individuals from six countries (Turkey, United States, United Kingdom, Belgium, Greece, and Croatia), and included four graduate students from the Nautical Archaeology Program at Texas A&M University. Donny Hamilton served as the Project Director until mid-July, when Deborah Carlson assumed that post until the end of the field season in late August. Ms. Gülnaz Savran of the Muğla Preservation Council served as the representative of the Turkish Ministry of Culture. Generously supported by the National Geographic Society, Spiegel Television, the Samuel H. Kress Foundation, Texas A&M University, and the directors and friends of the Institute of Nautical Archaeology, the 2007 field season marked the third consecutive campaign at Kızılburun and the second season devoted to removal of the ship's marble cargo in search of surviving wooden hull remains.

The marble carrier currently under excavation is one of five shipwrecks discovered at Kızılburun on a 1993 INA survey directed by Cemal Pulak (*The INA*

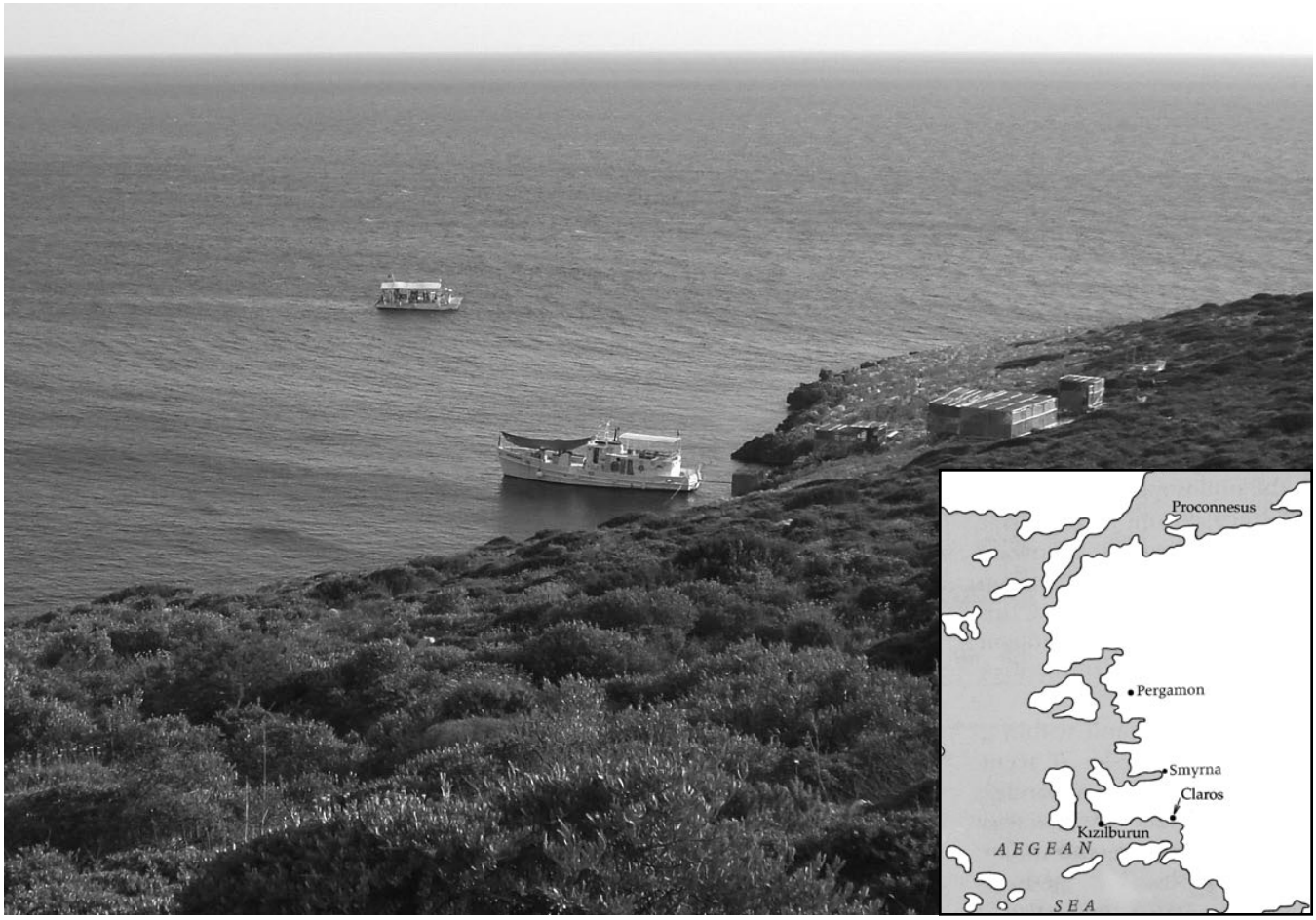


Fig. 1. *The Kızılburun cape, with INA's* Virazon *moored in front of the excavation camp and the catamaran* Millawanda *marking the approximate location of the column wreck (photo by Bastian Seidel)*

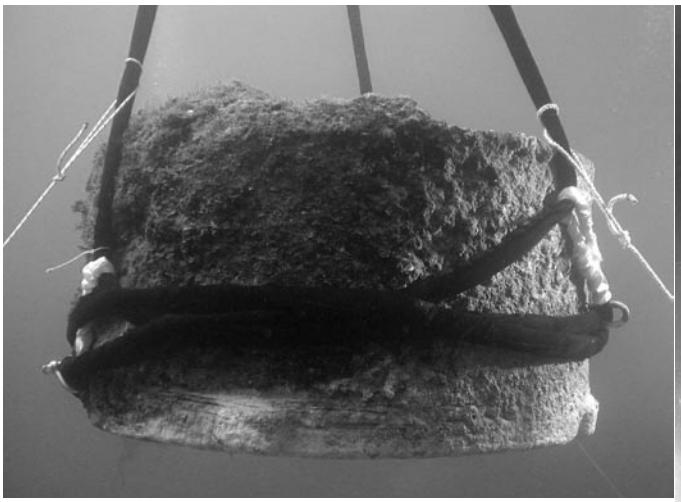
Quarterly 21.4). This vessel was transporting a cargo of newly-quarried white marble from the island of Marmara (ancient Proconnesus) in the sea of the same name, when it sank off Kızılburun, probably some time in the first three quarters of the first century B.C. There are several features of the Kızılburun marble cargo that distinguish it from other shipwrecked marble shipments discovered around the Mediterranean: first, the depth of the site (40–50 meters) appears to have minimized significantly or prevented altogether any attempts to salvage artifacts from the wreck. Second, the largest and heaviest of the architectural marbles at Kızılburun are not blocks or monolithic column shafts, but eight large drums and a single Doric capital that together create most or all of a monumental Doric column, almost certainly destined to complete the façade of a temple. New temple construction in the Doric style, however, is a relatively rare phenomenon in the first century B.C., which suggests that it will be possible to narrow the list of candidates to a handful of sites. Third, the unity and integrity of these eight drums, which were discovered arranged neatly in four pairs much like they must have been positioned inside the ship's hold, implied that portions of the vessel's wooden hull may be preserved beneath them. The opportunity to study and learn more about the construction details of what is likely to have been a purpose-built marble carrier was a compelling factor in undertaking this excavation.

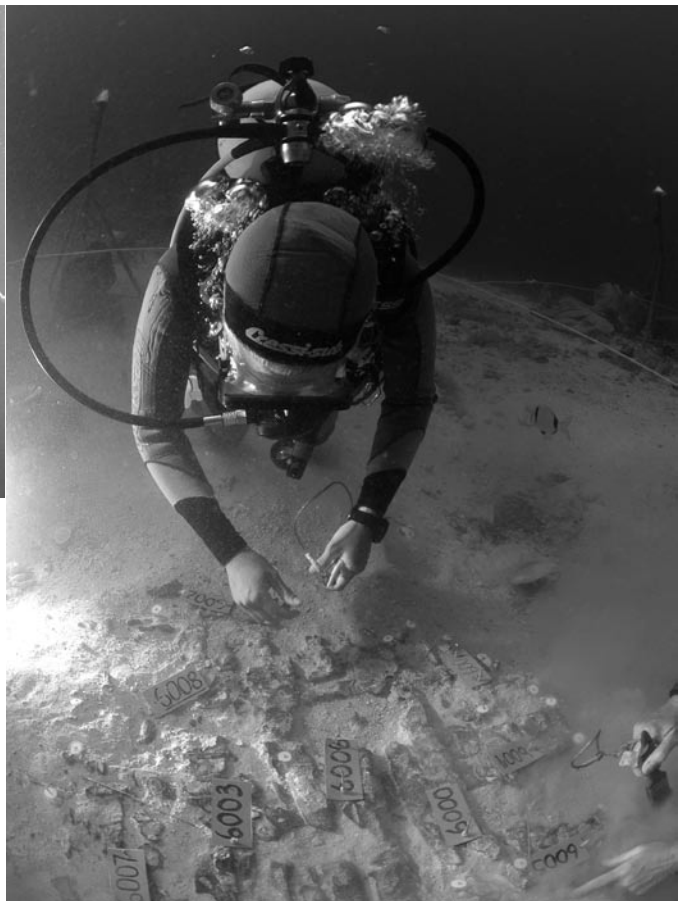
Fig. 2. *Orkan Köyağasioğlu and Feyyaz Subay make a final inspection of the rigging on the Doric capital.*

Two previous seasons of excavation (*The INA Quarterly* 33.1, 34.1) have revealed that, in addition to the primary column cargo, the Kızılburun ship was also transporting smaller quantities of roughly-finished marble objects, including pedestalled basins and grave markers. A wide variety of ceramic artifacts associated with the column wreck includes wine jugs, drinking cups, plates, moldmade bowls, and oil lamps, as well as fragments of coarseware pans, lidded casseroles, and transport amphoras from the Adriatic, East Greece, and the Black Sea. Many of these pieces are typical Late Hellenistic shapes that were circulated widely around the Mediterranean, while others—like the three Colchian amphoras from the wreck—represent the only known examples from a shipwreck context. The ongoing conservation, reconstruction, and analysis of this ceramic corpus may provide our best hope of refining even further the date of the Kızılburun shipwreck.

In 2006, with the help of four 1,800-kilogram lifting balloons donated to us by Richard Fryburg of Subsalve, Inc., we began the process of rigging and moving off site the wreck's massive marble column drums, which weigh approximately seven tons a piece. Each drum was outfitted with a 'basket' of three nylon lifting straps, carefully worked into place under the very bottom surface, which was often situated directly atop fragmentary and very fragile wooden timbers. At the conclusion of the 2006 season, we had successfully and safely relocated half of the eight drums (nos. 5, 6, 7, and 8), leaving four drums and the column capital *in situ*; raising these remaining marbles was the focus of our efforts at the start of the 2007 season.

Before the renewal of archaeological work could proceed, however, a small group of local carpenters led by INA staff member Mehmet Çiftlikli spent four days at Kızılburun rebuilding several vital camp structures





Figs. 3. and 4. *Drum 4 rigged with the Lift-All slings in a triple choker hitch, moments after it was lifted off the seabed; two of the four levering bosses are visible along the bottom edge (photo by Sheila Matthews); Carrie Atkins prepares the excavated planks in U6 (area* **U***nder drum* **6***) to be lifted and brought to the surface (photo by Don Frey).*

damaged or destroyed by rough winter weather. The initial 15-person excavation team, already assembled at INA Headquarters in Bodrum, arrived at Kızılburun on June 4 with INA's research vessel *Virazon* and catamaran *Millawanda*. Archaeological working dives began just over a week later, following the completion of the check-out and acclimation dive sequence and the installation of safety tanks, the telephone booth, datum towers, and airlift pipes.

Our first goal of the 2007 season was to complete the process, initiated the previous year, of ballooning off site each of the monumental seven-ton marble drums. We were extremely fortunate to have at our disposal an array of polyester lifting slings, manufactured by Lift-All, Inc. and provided at no expense to the Kızılburun project by Lift-All president Jeff Klibert. These continuous loop slings, which stretch very little and are abrasion-resistant, made it possible to rig and lift each drum by the side wall, without disturbing any of the fragmentary wood remains preserved beneath (*The INA Quarterly* 34.3).

As we had little practical experience with this new technology, Virazon captain Feyyaz Subay spent much of the first two weeks at Kızılburun experimenting with different combinations of slings and hitches, and testing them on several of the drums moved off site in 2006. In the end, we settled upon a triple choker hitch assembly, securing the opposing slings to one another with shackles to prevent the rig from riding too high or slipping off the drum. We proceeded with the same balloon configuration utilized in 2006, attaching two 1,800-kilogram lift balloons to a chain directly above each drum, and securing the two other "control balloons" to the top of the chain in approximately 10 meters of water. The two deeper balloons were filled first, and then the shallower two were filled remotely, via a hose supplied with air from tanks in a dinghy at the surface. This use of control balloons near the surface ensured that when all the balloons were filled and the drum left the seabed, there was no chance of the balloons (and the drum attached to them!) becoming overly buoyant and shooting to the surface. Thus, when the upper balloons broke the surface of the water, a recovery dive team was dispatched to the wreck to complete the relocation of the drum to an open, sandy area away from the wreck (in less than 20 minutes!). This process was achieved by filling smaller balloons attached to the drum with lines that ran through pulleys secured to the seabed. When the smaller balloons were inflated, they pulled on the lines that guided the drum downward onto the seabed. The addition of the Lift-All lifting slings constituted a vast improvement over the more time-consuming technique employed in 2006.

Most of the 2007 team spent the first week under water removing rocks and sand overburden from the area upslope of the drum pile. At the same time, a smaller group experimented with the lifting slings, carefully observing their properties under water by test-rigging drums 5 and 7, which had been moved off site in 2006. On June 19, we removed the single six-ton Doric capital from the top of the drum pile (fig. 2), and began airlifting sand away from the center of the remaining four drums in preparation for their removal. In fewer than two weeks, we safely and successfully lifted and moved the last four remaining marble column drums (nos. 1, 2, 3, and 4).

Only drum 4, the largest and heaviest of all eight drums, came with some difficulty, as the initial surge off the seabed caused one of the two upper balloons to tip and partially deflate at the surface, sending drum 4 back toward the bottom, directly atop one of our rebar mapping stakes, which it bent like a clenched nail. But when the upper balloons were re-inflated minutes later and drum 4 bounded back into the water column, it was possible to see that the bottom edge of the drum is distinguished by four small rectangular protrusions or 'feet' (fig. 3). These feet are the levering bosses designed to facilitate the final positioning of the drum by sliding it along a stone foundation; their presence confirms not only that drum 4 was intended to serve as the bottommost drum, but also that we are dealing with a column of the Doric order, since Doric columns sat directly atop the foundation course and not atop a base like Ionic and Corinthian columns.

On July 5, with all the column drums safely relocated off site, we turned our attention toward the excavation and recovery of the fragmentary timbers that we had glimpsed beneath drums 5 and 6 during the previous summer season. Drum 6 was the last to be moved at the close of the 2006 season, leaving us time only to cover, but not investigate, the wood that was visible when the drum had been raised. With the drum-lifting now complete, Texas A&M University graduate student Carrie Atkins began working in U6 (which designates the area Under drum 6), where she uncovered, in the uppermost layer, five longitudinal planking runs, each at least 9–10 centimeters wide and 2–5 centimeters thick (fig. 4).

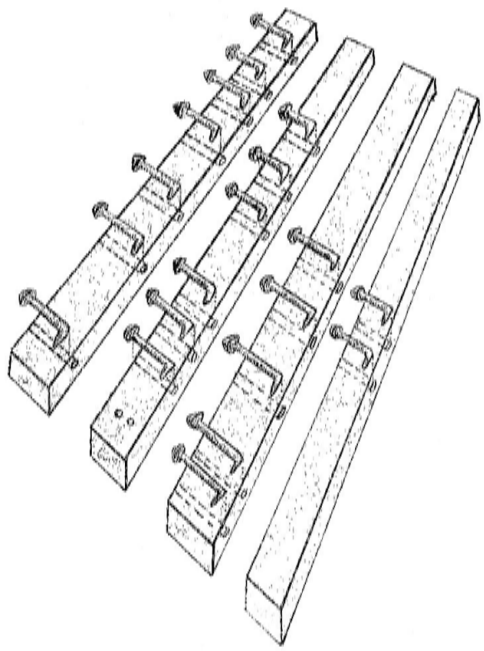


Fig. 5. *Tentative reconstruction of the clenched nails in four transverse timbers from U6 (drawing by Carrie Atkins)*

Beneath these planks in U6 were six thick, transverse timbers, each roughly 12–15 centimeters wide (sided) and 8–10 centimeters thick (molded). These thick timbers were better preserved toward the interior part of the ship, but in only one case was it possible to identify what appears to be a clean, finished edge with original surface. It became increasingly apparent that the transverse timbers had been fastened fairly regularly with clenched copper nails, but the clenched nail tips appeared on the molded, not the sided faces (fig. 5). In other words, these timbers seem not to have been attached to planking in the manner of a ship's frames. Carrie's work in U6 progressed slowly, due to the delicate and fragmentary nature of the wood remains. Once the six transverse timbers had been removed, we observed at least one additional timber, roughly square in cross-section, oriented longitudinally in the same manner as the thin planking atop the six timbers. Regrettably, there was not sufficient time to investigate this area completely, but the arrangement of the excavated timbers and the curious orientation of the clenched nails suggest that the wood remains in U6 are either (a) toppled half frames that were wrenched out of place and rolled 90°, or (b) some type of internal framework, such as a pallet, for supporting or bracing the drum(s).

On the western side of the site, under drums 1, 3, and 5 we exposed, mapped, and raised four thick and roughly-worked rectangular marble slabs of varying dimensions (labeled BAP, BAR, BAS, and BAT). With the two slabs raised in 2006 (BAK and BAL), this brings the total number to six, oriented in a line parallel to the keel (or where the keel should be), on one side of the ship only. Around and beneath these marble slabs, we exposed fragmentary remains of additional wooden timbers, comprised primarily of more transverse timbers lying

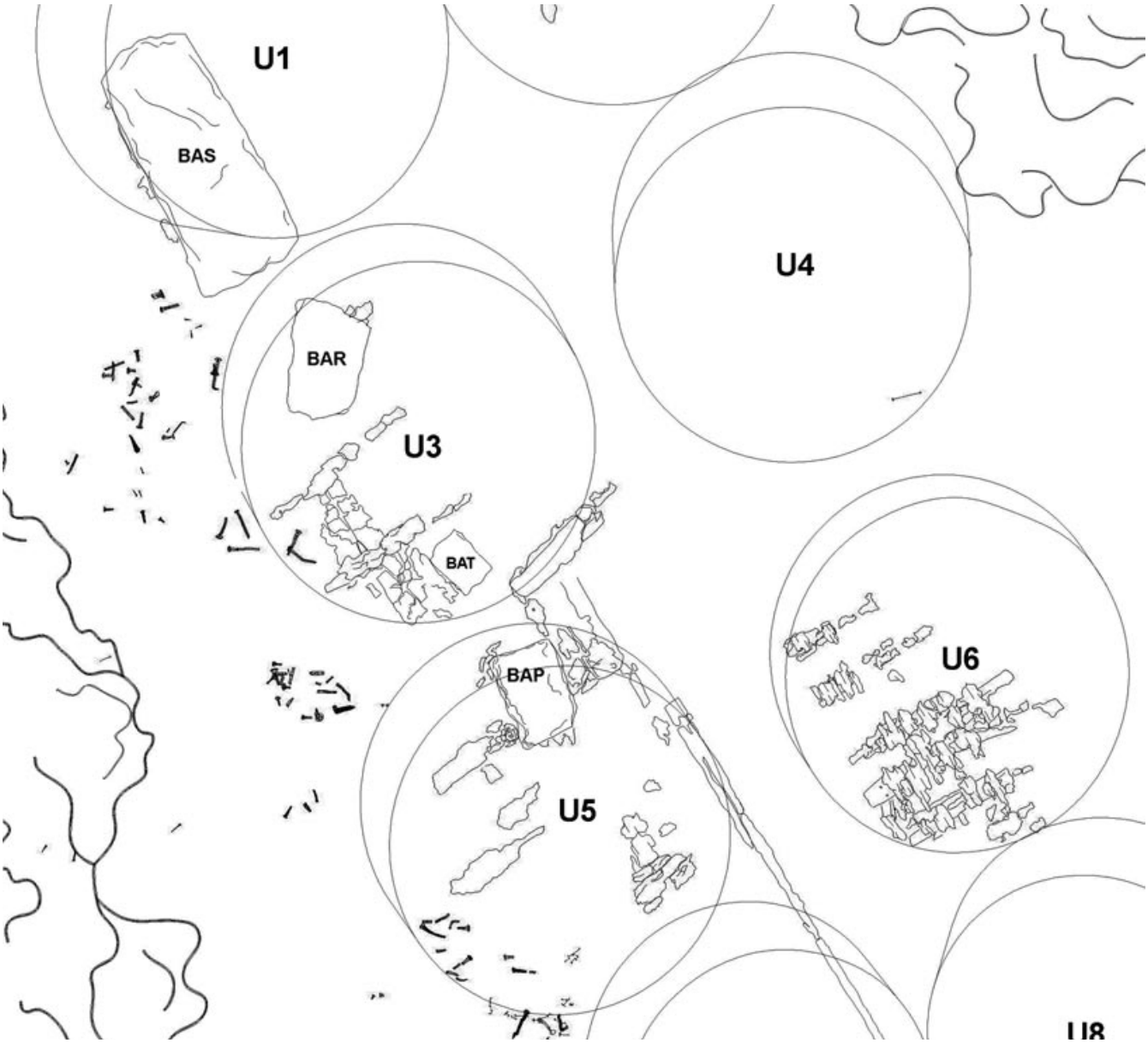


Fig 6. *Site plan from the 2007 season (drawing by Sheila Matthews)*

atop badly broken longitudinal planking (fig. 6). Within this planking we observed several examples of pegged mortise-and-tenon edge joinery, which is precisely the construction technique one would expect to have been used for the hull of a seagoing ship of the first century B.C.

Four wood samples collected from U3 and analyzed by Israeli researcher Nili Liphschitz of Tel Aviv University indicate that the thin longitudinal timbers are of black pine (*Pinus nigra*) while the thicker transverse timbers are a species of ash (*Fraxinus excelsior*). Black pine is a common species in the eastern Mediterranean, used for planking the hulls of ancient ships like the first century B.C. merchantman excavated at Madrague de Giens, France. The ancients knew ash to be a strong, durable hardwood with a high moisture content, which allowed it to be bent easily when green (Vitruvius, *de Architectura* 2.9.11). The archaeological evidence for its use by ancient shipwrights, however, is scarce; three half-frames near the stern of the Madrague de Giens ship were of ash, suggesting it was well-suited for use in areas that required additional strength (Theophrastus, *Historia Plantarum* 5.7.1–3).

While most of the 2007 team dedicated themselves

to the excavation, labeling, photography, and mapping of this extremely delicate wood (fig. 7), a small group took on the task of gathering more specific dimensional data on the ship's marble architectural elements. Our proficiency with the Lift-All slings made it possible to flip each of the eight drums 180° so as to expose the cleaner face, free of centuries of marine overgrowth (fig. 7). Each of the drums was then marked with small dots of high-contrast modeling clay and photographed extensively. The results are three-dimensional digital models of the eight drums and capital, which will aid our efforts to pinpoint the intended destination and function of this monumental column, as well as better understand the specific weight distribution inside the ship's hold.

As the excavation entered its second month, stormy seas on July 12 forced the morning evacuation of the *Virazon* and *Millawanda*, but the vessels returned in the afternoon and working dives continued uninterrupted. A week later, team spirits were buoyed by a visit from INA director Lucy Darden and her grandsons Chris and Frank. On the very next day, July 20, the team dispersed for a three-day break that coincided with the Turkish parliamentary elections. During this hiatus, veteran team member Kris Trego, a Ph.D. candidate at the University of Cincinnati, joined Deborah on a day-trip to nearby Claros, to visit the remains of the Temple of Apollo (see map inset, fig. 1). This was a Doric temple of white marble, initiated in the third century B.C. but still unfinished when the Greek travel writer Pausanias visited the site 500 years later (*Description of Greece* 7.5.4). Excavations by French archaeologists throughout much of the twentieth century have exposed significant portions of the temple's foundations, subterranean oracular shrine, and Doric column drums, the dimensions of which bear a striking resemblance to the unfinished drums at Kızılburun. In 2008, Deborah met with French and Turkish archaeologists working at Claros to discuss further these conspicuous similarities.

When work resumed at Kızılburun following the Turkish elections, we greeted our friends from Spiegel Television, who joined us as they had in 2006, to film the excavation in preparation for a documentary that appeared on German television in September (2008). Archaeological work continued in earnest until August 17, when we began breaking down the camp and packaging the artifacts for transport by truck to Bodrum. On August 20, the Kızılburun artifacts were signed over to Yaşar Yıldız, interim director of the Museum of Underwater Archaeology in Bodrum, where they are presently undergoing conservation. With the successful relocation of the ship's column capital and all eight drums, we estimate that the Kızılburun shipwreck excavation is nearing completion; of course, this estimation depends in large part on the quantity and quality of the unexcavated wooden hull remains, which are a complete unknown; either we have scratched the surface of what may be a well-preserved hull of the late Hellenistic period, or there is little left to uncover beyond the fragments that have been raised thus far. In either case, we aim to return to Kızılburun in 2009 to solve this interesting puzzle; in the interim, the summer of 2008 has been designated a study season, dedicated to researching the thousands of artifacts already raised from this important shipwreck.◆

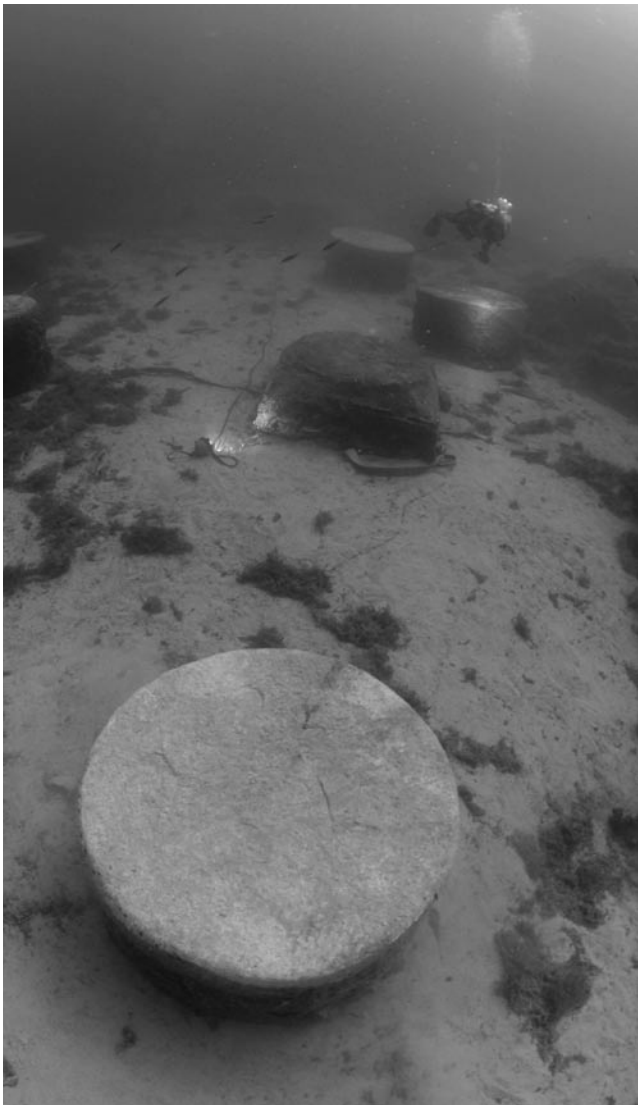


Fig. 7. *The drum garden, where we flipped each of the column drums once moved away from the wreck (photo by Don Frey)*

Acknowledgments

On behalf of the entire 2007 Kızılburun excavation team, we extend our sincere thanks to project director Donny Hamilton, commissioner Gülnaz Savran, the Turkish Ministry of Culture and Tourism, and the Turkish Coast Guard. Our success in moving the last of the marble column drums was due to the superb support of our friends at Lift-All, including president Jeff Klibert, engineer Andy Graf, those employees at the Houston plant where our slings were manufactured practically overnight, and sales manager Tim Gauss, who hand-delivered the slings to Deborah just two days before she flew to Turkey.

While on site, executive chef Fran White kept us all fortified with a seemingly endless supply of hot and tasty meals. Divemasters Vassilis Tsairis and Murat Tilev saw us safely through almost 1500 dives to the wreck site, and we were equally fortunate to be under the care of four talented hyperbaric interns from Çapa University (Gamze Öztürk, Sevi Tekin, Bengüsü Orodlu, and Ayşen Kolat), who served as our staff physicians for the duration of the season. Hüseyin and Muhittin Aldemir cheerfully attended to our many other needs, which included (but were not limited to) fuel, oxygen, drinking water, and weekly transportation. Special thanks also go out to our friend Murat Özakat for his generosity in allowing our fleet to utilize the fine facilities at Alaçatı harbor.

Over the course of almost three months in the field, our tireless team of 20 was reinforced by archaeologists Irena Radič, Susan Rotroff, and her husband Bob Lamberton. Welcome guests included INA director Lucy Darden and her grandsons Chris and Frank, David and Julia Koch (who generously provided this group of weary archaeologists with a stunning season-ending beach barbecue), Harun Özdaş, Ekin Özker, Tufan Turanlı, and visiting physicians Jim Hardy, Jen Harris, Chris Mills, Allison Mulcahy, and Akın Toklu. Back in Bodrum, Asaf Oron and the talented staff of the Bodrum Museum Conservation Laboratory, to which artifact illustrator Özgün Alpdoğan is the newest addition, ensured that the delivery and processing of artifacts went as smoothly as possible, while the rest of the INA staff always make the Bodrum Research Center a most welcome retreat at the end of an unforgettable summer spent along a remote stretch of the Turkish coast.

The 2007 Kızılburun team (front row, from left): Gülnaz Savran, Kim Rash, Bayram Kosar, Feyyaz Subay, Ege Savran, Don Frey, Johan Opdebeeck, Mike McGlin, Carrie Atkins, Fran White / (back row, from left): Zafer Gül, Giles Richardson, Sheila Matthews, Heather Brown, Kris Trego, Donny Hamilton, Murat Tilev, Debbie Carlson, Kruno Zubcic, Nicolle Hirschfeld, Eric Kemp, Vassilis Tsiairis, Sevi Tekin. Not pictured: Faith Hentschel, Courtney Higgins, Ayşen Kolat, Orkan Köyağasioğlu, Gamze Öztürk, Bengüsü Orodlu, Fred Roelens, Jeroen Vermeersch.

LAKE ONTARIO MARITIME CULTURAL LANDSCAPE PROJECT, 2007 SEASON

Gunboats, Shipyards, and Haydocks

Ben FORD

The purpose of the Lake Ontario Maritime Cultural Landscape Project is to integrate underwater and terrestrial archaeology into a holistic study of the shoreline. History shows that both Native- and Euro-Americans moved readily between water and land, making use of both environments for transportation, trade, communication, and recreation. Archaeologists, however, have generally created an artificial division in studying past human activity with "terrestrial" and "underwater" sub-fields, creating a distinction that members of an earlier culture or group may not have recognized. In an attempt to partially bridge this divide, the Lake Ontario Maritime Cultural Landscape Project is a survey of seven single square-kilometer areas along the eastern margin of Lake Ontario. Each of the seven survey areas (four of which were surveyed during 2007, fig. 1) is situated so that half of the area is on land and half is submerged, thereby spanning the shoreline and drawing on both terrestrial and underwater archeological techniques. This research also combines prehistoric and historic archaeology, ranging from ca. 5,000 years ago (the approximate date of lake-level stabilization) to 1900 A.D.

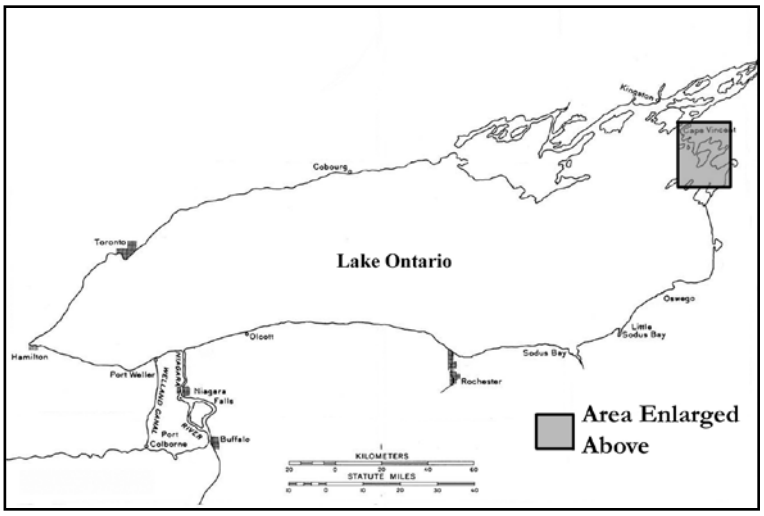


Fig. 1. *Map of Lake Ontario, highlighting general survey area (all figures by the author)*

The 2007 survey season was conducted during seven weeks in July and August. Each survey began with informant interviews to gather local knowledge and anecdotes, and to request land-owner permission. Many of the terrestrial sites were identified through this process. Where permission was granted, archaeologists walked the property looking for exposed evidence of archaeological sites. Identified sites were recorded with GPS, photography, maps, and a written description. Artifact collections were also reviewed and photographed.

The submerged portions of the survey areas were surveyed using magnetometer, side-scan sonar, and divers. Both the side-scan sonar and magnetometer equipment were on-loan from INA (fig. 2). In water deeper than approximately three meters, the remote sensing equipment was employed along transects spaced 15 meters apart. All potential targets were inspected by divers. In water less than three meters deep, divers swam transects 3–5 meters apart and oriented perpendicular to the shore. There was substantial overlap between the diving and remote sensing portions of the survey, and the magnetometer was worked into very shallow water in order to identify possible buried artifacts. All archaeological remains were recorded in situ and the coordinates were obtained from a differential GPS linked to the remote sensing software. All marine surveywork was conducted from the INA 18-foot *Achilles* inflatable and all of the equipment was powered by a bank of car batteries.

Sherwin Bay

The Sherwin Bay survey area (number 1 on fig. 3) identified one late nineteenth- century dock, a nineteenth-century farmstead, and several artifacts in the possession of local residents, including a Contact Period trade axe. This area also included the likely site of a Contact Period camp where Father Dablon, the seventeenth-century geographer and superior-general of Jesuit missions in New France and his followers were forced to spend several

days after wrecking their bateau. This area, however, was less productive than the others because its flat rock bottom permitted winter ice to regularly scrape the bay clean, and because high bacteria counts in the bay made it unsafe for diver inspections

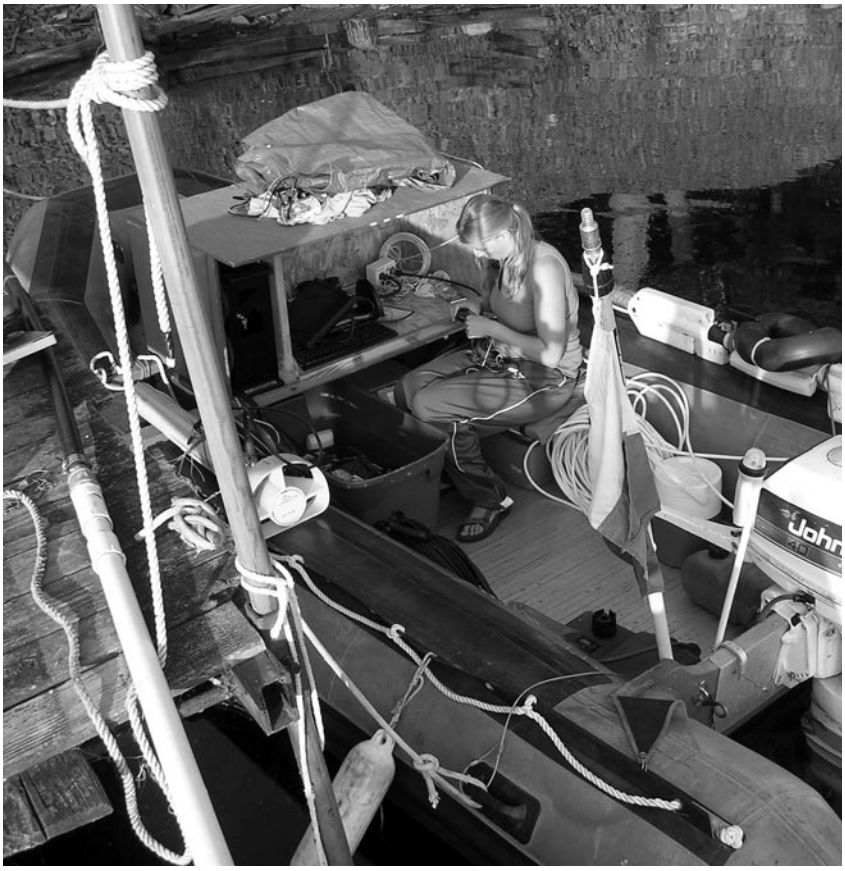


Fig. 2. *Jessi Halligan preparing the survey vessel for marine remote sensing. Note the side-scan sonar on the port gunwale and the magnetometer on the starboard.*

Long Carrying Place

The second area (fig. 3, number 2) is the Long Carrying Place on Point Peninsula. This narrow bay takes its name from the portage route that began and ended here. From the end of the bay it was an approximately one mile (1.5-kilometer) trek across the isthmus to a stretch of beach sheltered by Fox and Grenadier Islands, where boats could be put back into the water. There is some indication that Champlain was taken over this route during his tour of the lakes.

Eight archaeological sites were identified in this area, as well as one isolated find. The isolated find consisted of a 5.5-meter-long white oak timber that may have been lost from a timber raft originating at the Cherry Island lumbering operation. The archaeological sites in the area include the remains of a log cabin, three historic farmsteads, a blacksmith shop, at least two prehistoric sites, and a hay-dock with associated barn. Haydocks are often-rudimentary docks used to load locally produced grains onto small vessels for shipment to larger ports where the grains are accumulated and exported to market. There may be other sites situated in the inlet, as we recorded several magnetic anomalies in areas with deep muck. Unfortunately, none of these appeared to be the gold-filled cannon that lore has it was stashed somewhere in Long Carrying Place.

One of the prehistoric sites is likely the Northrop Site, a Middle Woodland Period group burial. The other prehistoric site consisted of a private collection accumulated by the farmer who worked the adjacent lands. The site was centralized near the head of the inlet and the density of the artifacts dropped off quickly on either side of the bay. Unfortunately, the collection has been lost so it is impossible to analyze the material, but it was likely associated with the portage. The log cabin may have also been associated with the portage; unfortunately it has also suffered from the ravages of time. What remained of the cabin was burned during the 1990s and no artifacts were visible on the surface. However, the site is situated on a point controlling access to the portage and with easy access to the water. It is also a substantial distance from the historic road, suggesting that it was intended to be approached by water rather than land.

Two of the farmsteads, one standing, the other an archaeological site, are representative of the mid- to late-nineteenth-century farms that line the road along the peninsula. The third farmstead is potentially more interesting because it is in association with the blacksmith shop and haydock/barn complex. The blacksmith shop was erected by an Abner Rodgers as early as 1840 and certainly prior to 1864, when it appears on a map. Based on later descriptions of the structure and its alterations, it is likely the structure still standing near the head of the bay. East of the blacksmith shop is the standing Becker home, built in the mid-nineteenth century and inhabited by Fred Bartell. Bartell was a cooper and boat builder, and conveniently operated one of the two major haydocks on Point Peninsula (fig. 4). The cooper shop next to the house was torn down in 1953

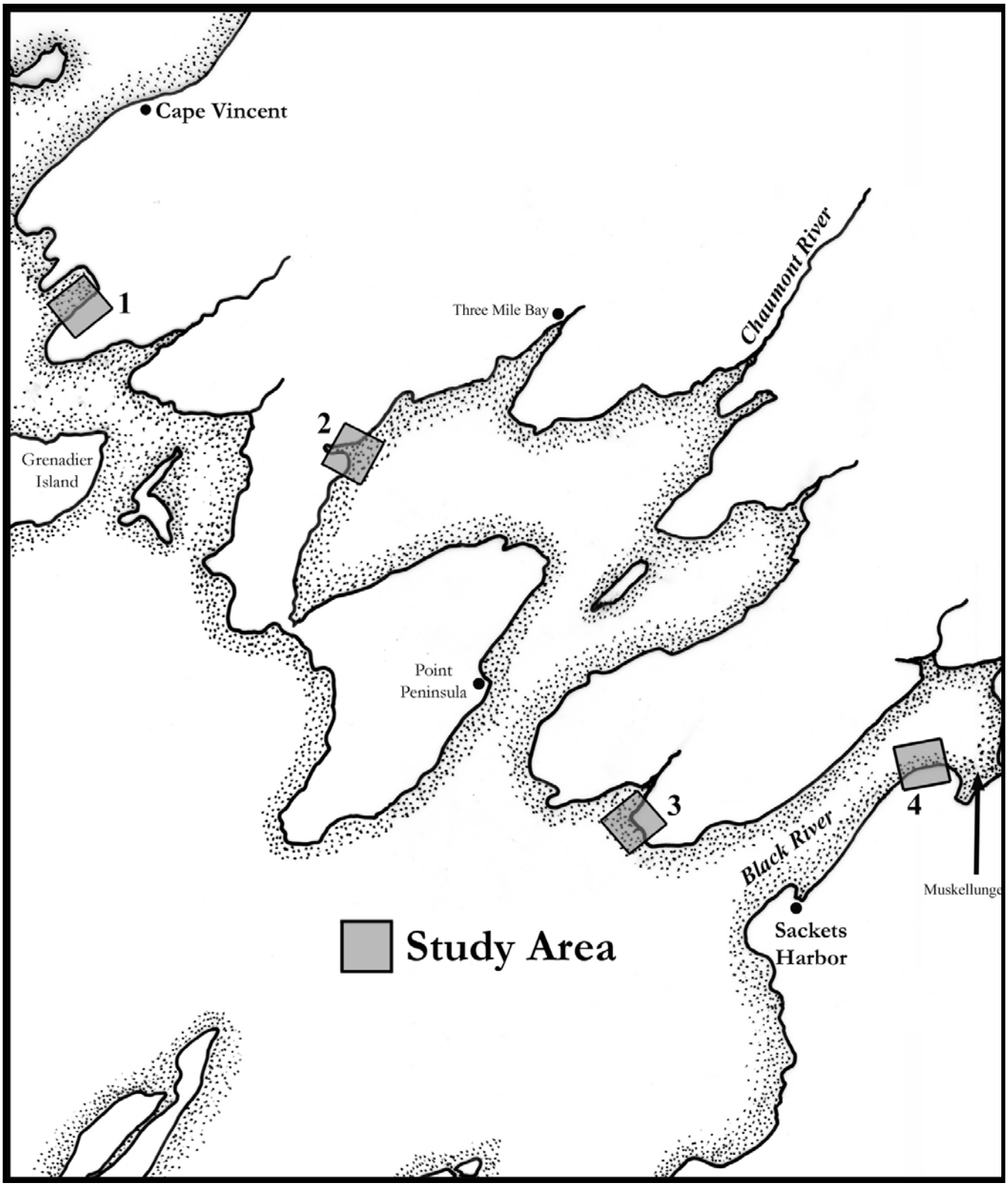


Fig. 3. *Lake Ontario Maritime Cultural Landscape Project survey areas, 2007 season: 1. Sherwin Bay 2. Long Carrying Place 3. Wilsons Bay 4. Storrs Harbor.*

Fig. 4. *Haydock at Long Carrying Place*

but the haydock is still intact. The remains of a sweeping path approaches the haydock from the main road and passes the foundation of the barn. The barn was built in 1885 based on a carved stone salvaged from the foundation and presumably was used to store grain prior to being loaded onto the scows. The dock took advantage of the protected nature of the inlet and the relatively deep water near its center to load grain grown on the peninsula onto scows for shipment to Oswego, Sackets Harbor, and Cape Vincent. Bartell seems to have taken advantage of the location of his home to expand his business from coopering to boat building (working under the "if you can keep water in a barrel you can keep water out of a boat" principle) and built many of the scows used in this trade, in addition to several fishing boats. The exact location of the boat building operation is unknown, but there is a graded area near the haydock that appears to be the most obvious spot for boat building. Thus, there was a small cluster of industrial activities: blacksmith, cooper, and boat builder, around the transportation node of the haydock. This cluster fulfilled many of the needs of the farmers strung along the peninsula between the towns of Three Mile Bay and Point Peninsula, and formed one of the primary links between the terrestrial agrarian system and the maritime transportation system.

It is also worth noting the coincidence of two different forms of transportation, historic and prehistoric, in this small bay. Native Americans and European Americans may have selected this spot for different reasons, but both groups likely benefited from the protection offered by the bay, although this may have been less of a concern for boats to be portaged with their paddlers. The visibility of the spot may have also been a consideration. The deep cut of the narrow bay, with its high bluff to the east, is easily identified from the water and may have made it a convenient location to begin a portage because it allowed each trek to begin from the same location reducing the chances of wandering off track. Similarly, the haydock may have been difficult to see, but its geographic setting would have permitted boatmen to easily navigate to it. This overlapping of historic and prehistoric sites along the shore is not uncommon, as suggested by the Storrs Harbor (see below) survey area.

Wilsons Bay

The Wilsons Bay survey area (fig. 3, number 3) was similar to Sherwin Bay in that its bottom was flat rock and there were large boulders piled around the margin attesting to the power of winter ice. This area yielded two nineteenth-century agricultural sites as well as a second haydock. This haydock was likely used to export grain to Sackets Harbor, situated immediately to the south. It was also purportedly used by rum runners during Prohibition because it was one of the last locations where illegal alcohol from Canada could be offloaded before passing the authorities as Sackets Harbor.

Storrs Harbor

Storrs Harbor (fig. 3, number 4) is situated just up the Black River from Sackets Harbor and much of its significance is due to its association with the American naval efforts at Sackets during the War of 1812. In early 1815 the approximately 2800-ton *Chippewa* was partially built on the site, sister ship to the more famous *New Orleans*, which was mostly completed at Sackets Harbor. Neither ship was finished due to the end of the war and the Rush-Bagot Treaty, and *Chippewa* was either dismantled or burned in the 1830s. The site of the shipyard structures, including a blacksmith shop and barracks, is currently being excavated by the Jefferson County Historical Society. Very little, if any, evidence of the ship shed and launching ways are extant above the shallow bedrock where the ship was built. Beyond the brief but intense spate of activity in 1815, historic maps indicate that Storrs Harbor was not intensively inhabited.

The survey of this area, however, identified eight sites besides the shipyard, as well as several isolated finds which included several unidentified pieces of iron, disarticulated wooden fragments, as well as an ice spud, a wrought iron mooring anchor, wooden dock fragments, what appears to be a boiler, and a ground-stone adze. The identified sites included at least two prehistoric sites as well as historic sites dating from just after the War of 1812 through the early twentieth century.

A Middle Woodland Period site, identified by diagnostic ceramics, is situated within the bounds of the War of 1812 shipyard. A second site or sites, known only from private collections was situated along the hillside to the east. Artifacts from these sites suggest Middle and Late Archaic occupations, as well Middle Woodland occupations and included a net weight.

The mid-nineteenth century Euro-American occupation of the area was represented by the associated remains of a farmhouse, barn, and ice house. The farm house was built ca. 1840 and torn down during the 1970s or 1980s. It exists today as a well-laid stone foundation with internal cistern. The barn associated with the house was converted to a living space and is inhabited by the current property owner. West of the barn and house, on property that was originally associated with the farm, are the remains of an ice house. Very little of the structure remains but the access ramp, cut into the steep cliff side, is still visible. The icehouse was in operation until the advent of electrical refrigeration and was one of the sources of ice for the Sackets Harbor area. Much of the forests of Storrs Point are cut through with stone walls and abandoned track ways, suggesting its agrarian past.

The Storrs Harbor area was also used by the US Army during the late nineteenth century. Situated on top of the hill are the earth and stone backstops for a firing range, used for rifle practice by troops stationed at Madison Barracks in Sackets Harbor during 1894. The range had a very short life because it was deemed unsafe shortly after completion. (Apparently, fishermen utilizing Muskellunge Bay did not like that any errant bullets would almost certainly land in the bay.) Likely associated with the firing range is a graded landing place along the shore of Muskellunge Bay just beyond the point. This landing place was excavated by soldiers from Madison Barracks at the turn of the twentieth century and was used for landing barges and for bringing caissons onto Storrs Point over the ice. According to informants, soldiers and cannons were regularly sent to Storrs Point by barge or over winter ice and then made to march the 2.5 miles (six kilometers) back to the barracks. Other elderly informants reported recovering large amounts of lead shot from two areas of the shore immediately west of the survey area. This shot was apparently deposited by soldiers from the ice, using the cliff face as a convenient backstop for winter target practice.

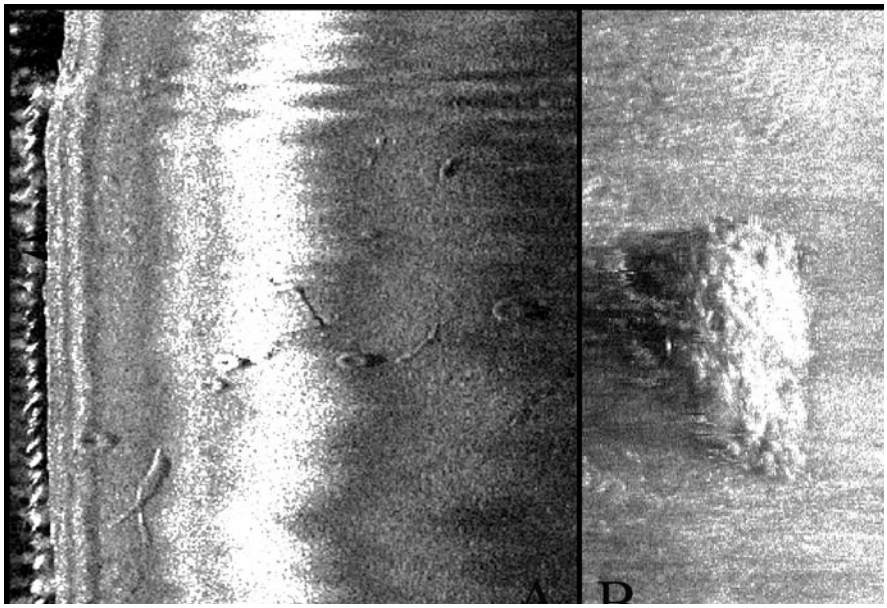


Fig. 5. *Side-scan sonar records of the dock cribbing (left) and ballast pile (right) situated within the Storrs Harbor survey area*

Two other sites in the Storrs Harbor area are more difficult to date. A 1.2-by-1.5-meter stone-filled wooden crib (fig. 5) was situated approximately 40 meters offshore, 100 meters west of the 1812 shipyard site. It was constructed of 8–13-centimeter-thick rectangular timbers and protrudes only slightly beyond the sediment. This cribbing is not associated with any modern or historic structures and may be associated with the shipyard. However, ice in this region can be devastating, and, despite being intact, the cribbing may have been moved from elsewhere. More likely in situ is the possible ballast pile located in the northeast corner of the survey area. This lozenge-shaped pile of is oriented NE/SW and measures 10.7 meters long and approximately 4.6 meters wide. The majority of the stones in the pile were flat,

measuring 60 centimeters in diameter and 1.3-4 centimeters thick. If the pile is in fact ballast, it is not likely a shipwreck, rather it may be from a vessel preparing to take on cargo in Sackets Harbor, or possible one that found itself grounded in the shallow water at the mouth of Muskellunge Bay.

A more likely candidate for a shipwreck was the series of magnetic anomalies that were recorded in the sandy shallows not far from the ballast pile. An 1829 chart indicates a nearby location as the wreck of a gunboat. The wreck occurred when one of the 15 75-foot gunboats (built during the final push of 1815) that were moored at Storrs Harbor broke free in a storm and became lodged on a sandbar. While it is difficult to match the historic chart to the modern landscape because it contains few hard points and the shoreline has changed dramatically over the last 180 years, the coincidence of several magnetic anomalies spanning several survey lines to form a linear pattern in an area that is likely to contain a wreck is heartening.

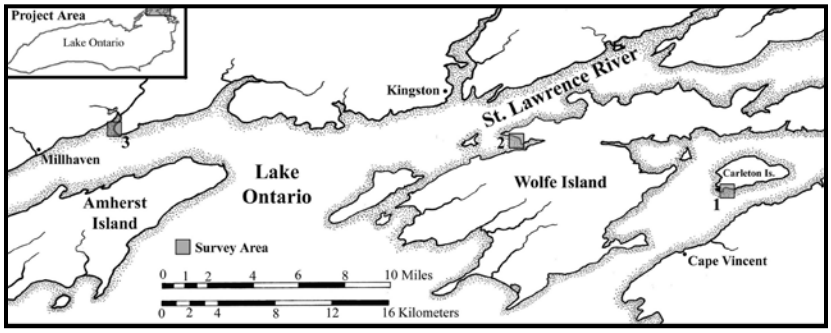


Fig. 6. *Lake Ontario Maritime Cultural Landscape Project survey areas, 2008 season*

The Storrs Harbor area can be interpreted from a number of vantages, including the repeated interface between land and water in military service at the beginning and end of the nineteenth century as well as the use of the shoreline for agricultural industries such as ice harvesting. The area also lends itself to some interesting preliminary conclusions regarding Native American use of the shore. At both Long Carrying Place and Storrs Harbor there is evidence of repeated pre-Contact Native American habitation in specific locations along the water's edge. In the case of Middle Woodland peoples, there is some suggestion that the preference was for high ground overlooking the water. This information is even more striking when the material record of these two narrow inlets is compared with the broader rock bays that typified Sherwin and Wilsons Bays. At these locations there was comparatively little prehistoric material. Thus, it seems that Native Americans had a preference for narrow inlets, possibly as they offered good opportunities to seine for fish as suggested by the net weight recovered from Storrs Harbor.

Conclusion

The Lake Ontario Maritime Cultural Landscape Project is ongoing and the 2008 season will be completed between May and July. Three additional survey areas, spanning the international border and including the important Revolutionary War site of Carleton Island will be completed during that time (fig. 6). The combined results of the seven surveys will be analyzed to address how people used the shore landscape and how those changes shifted with time, technology, and culture. Any reading of Lake Ontario's history is filled with individuals that made their living on both sides of the waterline. Barzillai Pease, who was a pilot on the Hudson River for Robert Fulton and operated the early steamboat Ontario on Lake Ontario, but also made his living as a land-based merchant and farmer, is an example. Fred Bartell, the cooper and boat builder of Long Carrying Place, is another. Thus, the history of the shore is seamless, with humans moving easily from water to land, utilizing resources throughout; archaeological investigations and interpretations should likewise be seamless. Ultimately, it is the goal of this project to contribute to this integrated and more holistic approach to maritime archaeology.

Additional information regarding the 2007 season, as well as updates on the 2008 season are available through a web journal hosted by the Museum of Underwater Archaeology (www.uri.edu/mua/).◆

Acknowledgments

This project would not have been possible without the generous support of INA and the unflagging endurance of several current and former Nautical Archaeology Program students. A complete list of supporters and volunteers is available on the Museum of Underwater Archaeology website, but Drs. Kevin Crisman and Donny Hamilton deserve special recognition for their support of this research, as does director John DeLapa for helping to fund the 2007 season.

THE FRIGATE ERTUĞRUL

The 2007 Underwater Survey off Oshima Island, Japan

Berta LLEDÓ and Cemal PULAK with contributions by Kazuhiro Hantani and Selçuk Kolay

While the work of the Institute of Nautical Archaeology in Turkey is well-established—Uluburun, Yassıada, and Serçe Limanı are among its most famous excavations and INA's Research Center in Bodrum has served as the administrative center for an even wider-ranging list of archaeological work that continues to contribute to the institute's success—it may come as some surprise to the reader that up until recently, INA had never excavated a shipwreck directly related to the modern history of Turkey. Furthermore, when it did so, it took place at a site off the eastern shores of Japan.

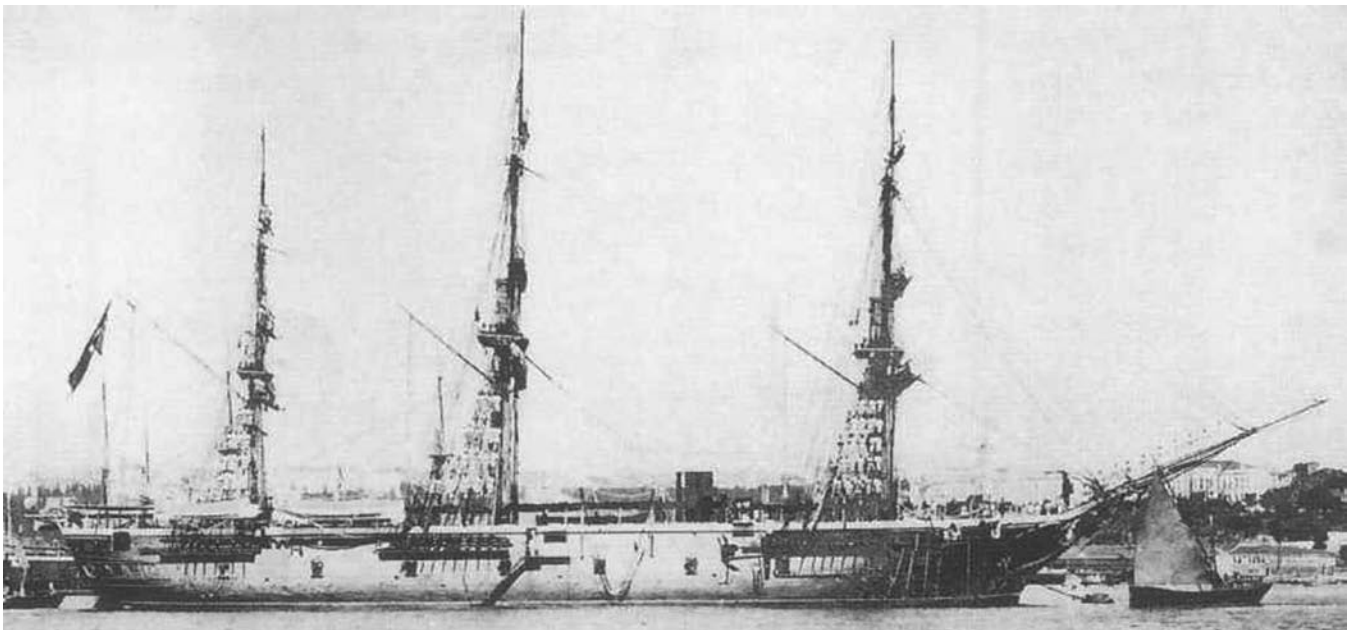


Fig. 1. *The* Ertuğrul *in Istanbul Harbor in an undated photo (All images in this article courtesy* Ertuğrul *Project archive (Randal Sasaki, Tufan Turanlı, Yasar Anter, M. Akagi and Idil Resa)*

In 2004, INA Bodrum Research Facility administrator Tufan Turanlı decided to investigate firsthand the remains of an Ottoman frigate, tragically sunk in a storm while returning from Japan in 1890 and salvaged piecemeal in the years shortly thereafter. While the devastating nature of the vessel's sinking, as well as the history of typhoons in the region, did not offer up much promise of finding hull remains, it was believed that the interesting stories and other, more personal artifacts involved would spark public and official interest not only in the project but in INA in general.

After considerable planning, in January 2007 an international team led by INA Turkey, with Tufan Turanlı as director/coordinator and INA vice president and Texas A&M Nautical Archaeology Program professor Cemal Pulak as archaeological director, went to the area of the shipwreck to conduct a thorough sonar, magnetometer, and visual underwater survey that prepared the team for the forthcoming years of excavation and conservation.

The Ertuğrul: Historical Background, Voyage and Tragedy

The frigate *Ertuğrul* was a wooden, full-rigged ship ordered built by the Ottoman Sultan Abdülmecid I in 1854 in Istanbul's Taşkızak shipyard and launched in 1864. Shortly afterward she sailed to England to be equipped with electrical lighting and outfitted with machinery and boilers. On January 18, 1865, the *Ertuğrul*

left Portsmouth, visiting several Spanish and French harbors on the long return trip to Istanbul and, in 1866, taking part in the Ottoman Cretan Campaign. Upon its arrival in its home port the frigate fell into a period of disuse. In 1889, however, after long and considerable assessment, the 25-year-old *Ertuğrul* was chosen for a noble mission: a diplomatic trip to Japan. The mission was a visit to Emperor Meiji in return for the 1887 visit to Istanbul of his nephew Prince Komatsu and his wife.

In order to prepare her for the long (approximately 9,500-nautical-mile) journey, the frigate was taken to the shipyard in Istanbul for the necessary hull maintenance work, although nothing was done on the machinery installed in England 24 years earlier. In July 1889, the *Ertuğrul*, with Admiral Ali Osman Pasa serving not only as the commander of the ship but also as the sultan's diplomatic envoy, began her journey to Japan.

Technical details of *Ertuğrul*:
Tons burden: 2,344 tons
Length: 79 m (260 ft)
Beam: 15.5 m (51 ft)
Draft: 8 m (26 ft)
Depth of hold: 25.6 m (84 ft)
Propulsion: two horizontal engines of 600 hp

Armament:
8x 15 cm Krupp guns
5x 150 lb (68 kg) Armstrong guns
2x 4, 2x 3 font Krupp guns
2x 5-barreled Hotchkiss guns
2x 5-barreled, 4x5-barreled Nordenfeld guns
1x 12-lb and 1x 6-lb rocket launcher
1x torpedo launcher
2x torpedoes
100x Martini-Henry rifles
100x Winchester rifles
40x pistols

The voyage was not easy. Besides the requested courtesy and diplomatic stops in friendly countries, the old frigate had many hull and maintenance problems along the way that had to be solved. The first occurred within a month of departure, when the *Ertuğrul* entered the Suez Canal and ran ashore in Great Bitter Lake, damaging the stern post and rudder in the process. It took almost two months repair the damage, and she set sail again on September 23rd. In western Indian Ocean, the ship took on water from the bow. The necessary repairs had to wait until arrival in the port of Singapore, from which *Ertuğrul* and her crew departed on March 22, 1890.

On June 7, 1890, at the end of 11 months at sea, the frigate finally arrived in Yokohama, Japan. After a very successful three months in the island nation, attending official events and meeting the Emperor Meiji, the Turkish dignitaries and crew of the *Ertuğrul* started their way back to Turkey on September 15, 1890.

According to recollections of the survivors, shortly after their departure a reverse wind began to blow, gaining in strength until at some point the sails had to be furled. The frigate could hardly advance. The 40-meter (130-foot) high mizzen mast collapsed and caused severe damage by knocking from side to side and banging into the other sails. The severity of the storm caused the deck planking at the bow to loosen, allowing water to seep into the coal bunkers in the boiler room. The crew fruitlessly tried to repair the deck while simultaneously bailing out the coal bunkers by hand, since the mechanical pumps were insufficient.

Despite all efforts, the situation was unsustainable and the only option was to reach a nearby port. The *Ertuğrul* was pointed toward Kobe, only 10 miles away, in the gulf beyond Cape Kashinozaki with the Oshima Lighthouse. The seawater breaking through the deck finally extinguished one of the furnaces in the engine room. Almost immobile without her main sails and sufficient propulsion, the *Ertuğrul* drifted towards the dangerous rocks on the eastern coast of Oshima Island.

The crew tried to stop the frigate with emergency anchors before it hit the reef, but they were too late. The 76-meter ship, according to survivors, split in half and sank. Of more than 600 sailors, 533 died that day. Sixty-nine survivors managed to reach the shore near Kashinozaki and climbed up a steep and rocky cliff to the lighthouse. The accident was then reported and the entire village of Kashino on Oshima island worked on rescuing and caring for survivors of the accident.

The exact time and date of the collision is still under discussion since there are certain discrepancies between Turkish and Japanese sources. It seems that the frigate reached her fatal destination at approximately 9:00 p.m., September 16th, 1890. Nevertheless, some sources describe the incident as a two-day-long fight against the storm that ended around midnight on September 18th, 1890.

At that time, there were about 50 households in

Kashino. The inhabitants all lived in poverty, a poverty increased just then by poor luck in fishing due to the bad weather. Nevertheless, the local people offered everything they had to those who survived the wreck of the *Ertuğrul*, a ship from an entirely unfamiliar country, Turkey.

When the news reached Tokyo, Emperor Meiji sent medical help to the village and shortly thereafter, on the 20th of September, the survivors were sent to a hospital in Kobe for their final recovery. On the 5th of October, by Imperial order, two Japanese warships, *Hiei* and *Kongou*, were assigned to take the *Ertuğrul* survivors back to Turkey. Condolence money was collected from all over Japan and delivered to the families of the accident victims.

This unfortunate event remains to this day the biggest naval disaster in Turkish history, and its circumstances cemented the long and enduring friendship between the modern nations of Japan and Turkey.

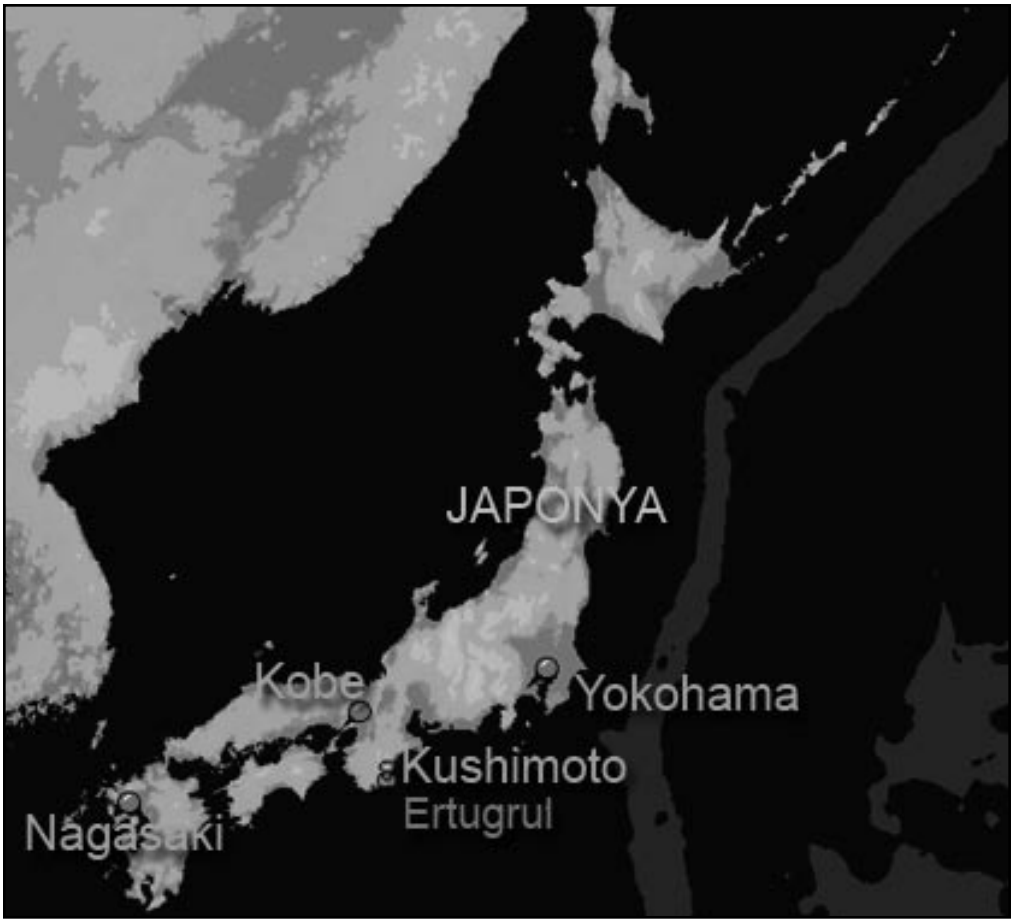


Fig. 2. *Map indicating general location of* Ertuğrul, *which sank after hitting a reef off of Cape Kashinozaki on the eastern coast of Oshima Island, soon after leaving a three-month diplomatic mission to Yokohama*

The 2007 Ertuğrul Survey

The purpose of the 2007 survey at Oshima Island, Japan, was to determine the importance of the *Ertuğrul*'s remains and to ascertain the area of the wreckage.

It was known that there was little possibility of finding any considerable remains of the *Ertuğrul*'s hull in its original shape due to the manner in which the frigate sank as well as the hydrographic and meteorological nature of area, which has been hit by many typhoons since 1890.

Nevertheless, the *Ertuğrul* was a massive wooden steamship, a navy frigate with three masts and sail, cannons and armor. It is known that the cannons were salvaged in the Meiji Era, and it now appears that much of the ships usable hardware, guns, and some personal possessions were salvaged by Japanese divers and returned to Istanbul. The large guns were apparently used later on another Turkish frigate built at Taşkızak, the *Orhaniye*. The ship's boilers, screw, and other large parts were probably salvaged the year following the ship's sinking and sold off by the Japanese salver/divers for scrap metal to pay for the salvage operation. Nevertheless, it was anticipated that some large metal parts were still at the bottom of the sea, as well as most of the smaller machinery components and personal effects.

Between the 6th and 25th of January 2007 three teams worked on the *Ertuğrul* site, some of them simultaneously. One of the most important research components was a multi beam sonar survey conducted from January 9–11 to cover the sea bottom systematically near the well-known wreckage area to learn if there were any large parts of the ship remaining, and to collect precise infor-

mation on the seabed topographies and on the condition of scattered remnants at the point where the ship sank.

To obtain such vital information, we used RESON Inc.'s SeaBat8125 High Resolution Multibeam Echo Sounder. The sonar operating frequency was 455kHz, and beamforming echoed into 240 of 1/2-degree beams up to a 120-meter range, achieving nearly a 6mm sampling resolution.

For positioning and motion/heading compensation, a GPS-aided Inertial Navigation System and a POS MV WaveMaster were used. The system was installed on a six-ton fishing boat, and the sonar head of the SeaBat8125 was firmly over-side-mounted on the ship. Displays were installed ion the rear of the deck to allow us to monitor the ocean floor and large remains in real time.

Fig. 3. *Multibeam echo sounding GPS, and WaveMaster systems were mounted in the stern of the survey boat to enable real-time monitoring of the seabed. The Oshima Lighthouse is visible on Cape Kashinozaki in the background.*

The multi beam survey was conducted in a shore-side area of about one kilometer southwest and 500 meters northeast from the shipwreck spot.

The bottom topography in this area was more complicated than we had expected; the depth suddenly changed from a few dozen meters to a few meters and in some occasions we had to suspend the survey due to boat and equipment safety considerations.

The real-time sonar data were difficult to interpret. A few targets were detected in the sand area off the coast, but it was impossible to distinguish them from rock formations without post-processing the obtained data A bathymetry chart of the entire survey area was created by post-processing the Multi beam Survey data with the HYPACK MAX Hydrographic Survey/Processing Software and Fledermaus 3-D Visualization Software.

We were unable to find any of the remains of the *Ertuğrul* in the multi beam survey. While the results could have been discouraging, they were in fact quite reassuring. The fact that no remains were found in the deeper waters around the wreck confirms the survivors' recollections of the accident. The *Ertuğrul* sank shortly after hitting the reef and went directly to the bottom of the sea, particularly the ship's heaviest parts, which were not salvaged and will remain in this area when the excavation starts.

Following the multi beam sonar survey results, we were quite sure that no major visible remains from *Ertuğrul* were present on the sea bed surrounding the area where the ship went down. To make sure that no such parts were buried in the mud/silt or sandy bottom which could not be detected by sonar waves (acoustically), however, a magnetometer survey was also completed in the surroundings of the main diving area thanks to OYO Corporation, which sent a team of technicians with the necessary equipment.

From January 13–15, the area previously surveyed by the multi beam sonar was divided in two sectors, which were each scanned by a Geometrics cesium marine magnetometer with an accuracy of 0.01 nano Tesla. Both sec-

tors were scanned by pulling parallel lines (50 meters apart from each other) to the shore. Again, this survey revealed no magnetic anomaly which could lead back to any buried metal remains from the wreck.

The reef area where the highest concentration of artifacts is found has been visited officially on different occasions: in the 1980s a local diving team recovered few well-preserved artifacts for the local museum; in 1990 a team from the Turkish Navy explored the site in the centennial celebration of the tragedy; in 2004 INA's Turanlı assessed the site for possible archaeological survey and excavation.

The scattered remains are found in an area of roughly one square kilometer near the local lighthouse, and features a very rocky shore with many rocks at sea level. The diving took place in this area to make a visual reconnaissance and a realistic assessment of the site for future excavation.

The main concentration of personal effects and ship's debris can be found in an underwater valley of roughly 70 by 15 meters flanked by high rocks at a maximum depth of 17 meters. The rough seas and long history of typhoons and storms have added more than 30 large boulders on top of *Ertuğrul*'s remains; they were all mapped and measured to estimate their weight and the possibility of their removal.

Most of the area was also investigated by metal detector. Many parts of the site registered higher frequency, indicating a high concentration of artifacts, especially in the north end of the valley where a large cooking pot and other artifacts were visible on the sea bottom.

A total of eleven artifacts were raised during the 2007 survey and given to the Kushimoto Turkish museum. Permission was granted by the Japanese authorities to temporarily take four of the artifacts to Turkey to complete their conservation process.

Two wood samples were also taken by Cemal Pulak to be analyzed and to determine the type of wood used in the hull. The samples were sent to Nili Liphschitz of Tel Aviv University. A wood fragment that seemed to be part of the hull was identified as *Quercus cerris* (Turkey Oak), which confirms that the surveyed remains indeed belong to *Ertuğrul*. The other sample was taken from one of the artifacts, a block sheave, and was identified as *Lignum vitae*, a hard tropical wood commonly used for this type of pieces since it endures well the humid marine environment.

Once in INA's Bodrum laboratory, conservators made an assessment of their preservation and completely desalinated them. They were cleaned and treated and then returned to the Kushimoto Museum for display in January 2008.

Figs. 4. and 5. *The main concentration of artifacts is in an area 13 meters deep. Sea action and currents are very strong in the area, as the photograph, above, demonstrates. Remains of a lantern and a pipe fitting can be seen in the foreground; part of a Winchester rifle concreted to the sea bed, below. Many of the 200 rifles on board were salvaged shortly after the accident and returned to Istanbul.*

Fig. 6. *Recovered artifacts: ERT 001: probable lantern remains; ERT 002: hinge; ERT 003: iron-wood sheave with copper alloy center piece; ERT 0004: bayonet handle; ERT 0005: pipe; ERT 0006: copper alloy sheave; ERT 0007: faucet; ERT 0008: bracket; ERT 0011: ammo shell bearing the star and the moon, symbol of the Turkish army.*

In days in which the wind was too strong to allow diving, the team collected local information about the wreckage from archives. In the days after the accident, local officials had recorded all the details of the events and of the rescue efforts by the local fisherman. There is a day-by-day account with locations of all remains and bodies found on the nearby beaches. Several documents were translated by Randall Sasaki, a graduate student in the Nautical Archaeology Program at Texas A&M University. Survey members also recorded several interviews with old women from the Kashino village whose fathers were young fishermen in 1890, and who could still recall the stories that their fathers used to tell them about the tragedy of the *Ertuğrul*.

Our Japanese Colleagues: Official Relations and Contributions

Official relations play an important role in any excavation and research procedure, especially when working in foreign countries. In the *Ertuğrul* Project case, official relations could not have been better. The municipality of Kushimoto and the governor's office of Wakayama, the prefecture in which Oshima Island is situated, were extremely happy with the presence of the Turkish team and gave all the logistic support that was requested from them.

At the end of our survey the municipality of Kushimoto donated the use of a large building—the former primary school of Kashino—as a conservation laboratory and research offices for the team in the forthcoming years. The Kashino fishing cooperative also offered the use of its harbor facilities to the project.

During the three weeks' duration of the survey a great deal of interest was generated in the Japanese press, including full-page articles and personal interviews with various team members. A total of more than 52 articles in the coun-

try's top newspapers were published and all of the main TV stations (NHK, TV Wakayama, Kansai TV, Asahi TV and Mainchi TV) came to cover the project's press conferences, as well as air special interviews and programs about the project. The coverage in the Turkish press was also good with an average of three minutes of news every day at the end of the news program on the Turkish Television channel.

We could personally experience the effectiveness of the press on the Japanese public since everyone coming to stay in our hotel from other parts of Japan knew who we were and what we were doing.

In Turkey the effect of the project on official relations has been very positive, having fed and renewed INA relations with the Turkish Navy and Coast Guard Forces— both key authorities for INA marine operations. The popularity of the everyday news about the project has help enormously to create general public interest in INA and its projects.◆

Acknowledgments

We were thrilled to have some guests of honor in Kushimoto, Japan like George and Ann Bass, Claude and Barbara Duthuit, and Donny Hamilton. Their presence gave great support to the project and generated a series of news articles about the history of underwater archaeology. They regularly joined the team on the boat and Mr. Duthuit participated in the underwater work.

Our team would like to thank the organizations that made the *Ertuğrul* Project possible, especially, YapiKredi Emeklilik, the Turkish insurance company that completely financed the *Ertuğrul* Project; Turkish Airlines, for contributing all transportation expenses; and INA for providing equipment as well as Tufan Turanlı's and Cemal Pulak's time.

We would also like to give special thanks to Kushimoto's Municipality for its unconditional support.

2007 Ertuğrul *Project team members, from left: Idil Ece Resa, Toshihisa Shirotsubaki, Hiroshi Enomoto, Selçuk Kolay, Randall J. Sasaki, Yoshiko Nakamura, Tufan Turanlı, Masakazu Akagi, Cemal Pulak, and Toshiyuki Shimano (in drysuit, far right). Not pictured:Claude Duthuit, Kazuhiro Hantani, Shunichi Fujishima and Akira Yoshizawa from RESON, Toyo Corporation, and Yoshinori Matsumoto and Yusuke Sugimoto from Windy Network; Sato Yoshibumi from Oyo Corporation and Isao Oogane from Ocean Engineering Corporation; Donny Hamilton and George F. Bass, advisers; Onur Küçükarslan, media manager; Keiichiro Kondo, general assistant, Japan NHK television; and Yaşar Anter, Doğan news agency.*

SEEKING EARLY BRONZE-AGE TRADE MARINERS

Underwater at Tell Fadous-Kfarabida, Lebanon

Ralph K. PEDERSEN

Dazzling sunlight poured through the crystal clear waters of the Mediterranean, illuminating the seafloor and the thousands of silvery fish circling me. It was a far cry from the past several days of diving in rough, wind-tossed seas that at times threatened to curtail our survey, if not break some bones. On land, a team of archaeologists from the American University of Beirut (AUB) excavated a nearby settlement nearly 5,000 years old. While the land archaeologists labored under the hot August sun, our job was to explore the sea. All this while not far to the north the Lebanese army battled Al-Qaeda-style extremists in Nahr el-Bared, the Palestinian refugee camp outside Tripoli. Helicopter gunships regularly flew overhead, ferrying arms and the wounded as a nation held its breath, shaking its head in despair and unbelief, and yearning for a chance to just live. Such is archaeology in Lebanon.

As part of AUB's archaeological project at the Early Bronze Age Tell Fadous-Kfarabida, in August 2007 I conducted an underwater archaeological survey of the shallow coastal areas related to the site. My survey goals were to determine whether there were subaquatic archaeological materials relating to the tell; to ascertain if there were indications of harbor works or a harborage associated with the site; and to discover whether shipwrecks of any period lay off the shore of Fadous-Kfarabida.

Fig. 1. *Pedersen enters the southeast corner of Tell Bay, where the beach slopes gently into the sea. Tell Bay may be the part of the seafront mostlikely utilized by the inhabitants of the Tell Fadous-Kfarabida for their fishing and other maritime activities (photo by Erik A. Pedersen).*

Geophysical Setting

The shore in the area of the tell is a mix of large rock formations interspersed with pebble and cobble beaches. A series of rock outcrops jut into the sea beginning in front of the tell and continue north to the small harbor of Fadous. South of the tell, the shoreline consists of a long cobble beach interrupted a kilometer or so to the south by a rock formation several meters high. The entire seafront is a lee shore regularly beaten by westerly winds and waves, abating to short periods of calm.

The winds and waves create a strong underwater surge, pulsing into the shore and then pulling out. This high energy action has undoubtedly eroded the shoreline over the millennia, particularly in those areas not benefiting from the protection of the rock outcrops. The wave effect is present even at

Figs. 2 and 3. *Tell Fadous-Kfarabida (above) dates to approximately 2900 to 2600 B.C. The excavation, under the direction of AUB professors Helen Sader and Hermann Genz, is essentially a rescue excavation as a large section of the tell was dug out in recent years for material to make cement; a view of the southern bay and cobble beach (below); to the right of center is Tell Fadous-Kfarabida (photos by Ralph Pedersen)*

depths of five to six meters some 30 to 40 meters from shore. As a result, little sand accumulates in the area except in zones protected by geological formations or by the collapsed seaward faces of the surface rock formations. Some gravel is present in the lee areas of the rock outcrops, but its presence and dispersal is not uniform. The gravel consists of well-rounded pebbles that indicates their erosion due to the sea action over the eons.

Further out, perhaps some ten to twenty meters beyond the edge of the rock buttresses, increasing bottom depth lessens the surge of the sea to almost nothing although severe winter storms probably disturb these depths. In this zone the sea acquires a stark beauty and large swaths of sand appear, accumulating in broad depressions in the bedrock that run roughly parallel to the shore. Beyond this, large areas of bedrock covered with vegetation and other rock-clinging organisms predominate. The seascape is broken, fractured by canyons and fissures whose bottoms are covered with loose sand but little else.

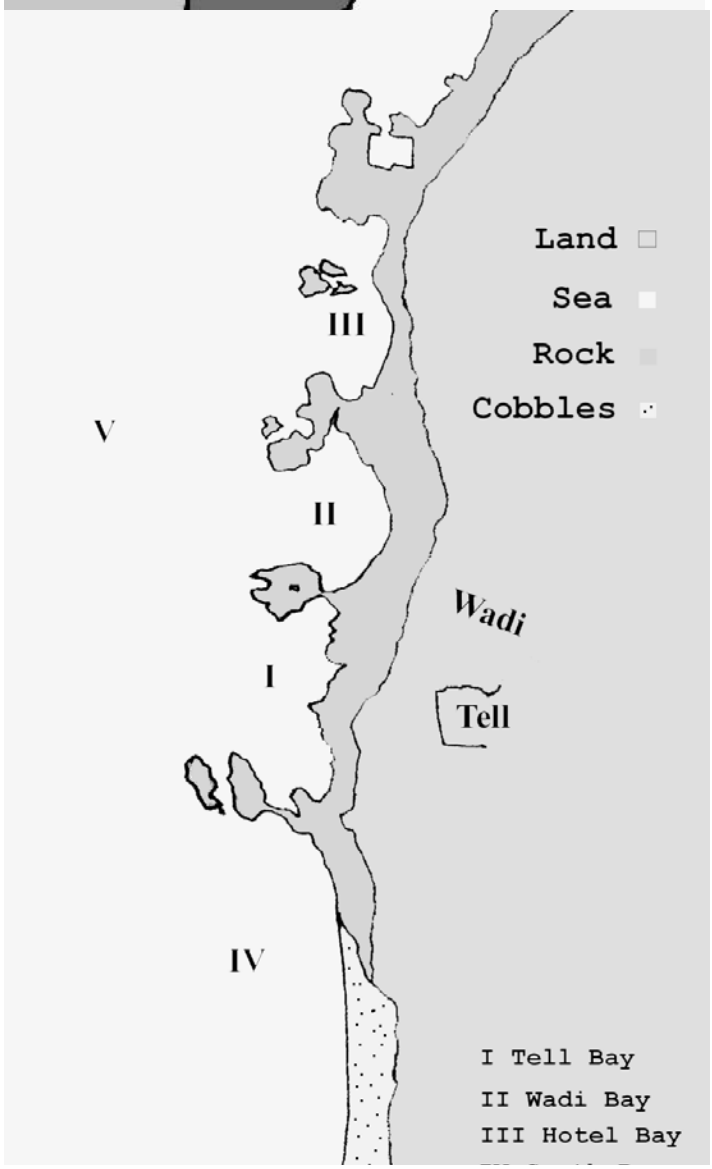
Methodology

The survey area was divided into five sectors. Three of these comprised small natural bays: one directly in front of the tell ("Tell Bay"), the second at the mouth of the wadi north of the tell ("Wadi Bay"), and the last fronting the Hotel Dorada in the northern part of our survey area ("Hotel Bay"). The fourth area was the large open bay to the south of Tell Bay. The fifth area was the open sea west of the bays to approximately 300 meters from shore where the depth reached 18 meters.

The areas, particularly the bays and the open western area, were surveyed utilizing a standard "search and recovery" pattern, in which each zone was traveled from end to end while examining the sea floor and geological features. The large open bay to the south was cursorily explored as vision was limited, with blind conditions in the zone nearest the tell. This curtailed survey efforts there as there was little sense to swimming blindly in rolling surf.

Survey Observations

As the shorefront at Tell Fadous-Kfarabida is a high-energy zone, pre-survey analysis indicated that artifact preservation there would be poor. With



Figs. 4 and 5. *A map of Lebanon (above) showing the location of the tell in relation to Beirut and Tripoli; the coast in the vicinity of Tell Fadous-Kfarabida (below) showing the designated survey areas (maps by Ralph Pedersen)*

prevailing waves pushing in from the west, almost all of Hotel Bay and Wadi Bay are exposed to waves. The bottoms in each of these bays are scoured to bare bedrock, with a few pockets of gravel, pebbles and cobbles. Rolling stones pushed back and forth by the sea have carved gullies and cavities into the bedrock, attesting to the energy of the sea and to the long-term duration of its erosive action. Entering Hotel and Wadi Bays required either descent in full scuba gear by ladder or a walking entrance which entailed picking our way over boulders; exiting meant clawing our way up a cobble-strewn slope on hands and knees while battling the force and suction of the waves.

The southern edges of each bay are in the lee of the rocks separating the bays from one another. Along these edges there is less wave action and these calmer areas were specifically targeted for survey. We also examined each bay for easy access points that may have been utilized by the ancient inhabitants of the area. Neither Wadi Bay nor Hotel Bay was easily accessible to the team and it is assumed similar conditions existed in antiquity due to the high rock faces.

Tell Bay, while subject to the same wave action affecting the other bays, contains areas of sand deposits, plant life, as well as fish and octopus gardens. Large rocks on the southern edge of the bay provide a semi-protected area blocking waves as well as wind. Abundant underwater springs create pools of fresh water on the surface as well as in subsurface areas during periods of calm, and it was actually possible to remove one's regulator and take a drink under the sea! The northern extremity of Tell Bay is more barren of marine life, as it is more exposed and scoured by the waves and rolling cobbles. On the bay's southeast corner the beach slopes gently into the sea providing an easy entry point, which makes Tell Bay the most useful nexus between sea and land in the area. The abundance of fresh water and fishes make it an attractive place for fishermen and this area is the closest protected access to the tell. We believe this is the part of the seafront most probably utilized by the ancient nhabitants of the tell for their fishing and other maritime activities. Indeed, one artifact was found in Tell Bay near the access point—a stone knife blade, possibly dating to the Neolithic period—indicates a long-term use of the area and underscores its usefulness in antiquity.

Along the edges of the rocky peninsulas, the sea becomes suddenly deeper, reaching to 4–6 meters, probably due to scouring of the sea over the ages. On their seaward faces, the sea becomes deeper still, reaching to eight meters. Here modern trash accumulates, washed down from the shallow areas of the bays. Bottles, cans, fishing gear, and tires litter the sea floor in places. Some broken pieces of modern pottery were found, as well as floor tiles from the construction of the nearby buildings, but no ancient artifacts were found around the rocks. Large

Fig. 6. *A view of the survey area looking south over Hotel Bay in the foreground, followed by Wadi Bay, Tell Bay, and in the back the southern bay (photo by Ralph Pedersen)*

Fig. 7. *A view of Wadi Bay, demonstrating the typical high rock walls along much of the shoreline (photo by Ralph Pedersen)*

boulders also abound, apparently broken off the larger rocks that comprise the peninsulas, smashed by waves over the years until fissuring occurred. Channels and pits carved into the sea floor occur here as well, testifying to the force of sea storms even at these, and greater, depths.

At about 200 meters from shore, in a depth of 10 meters or so, there is a long shelf facing landward. This feature protrudes above the sea floor 1–2 meters and lies roughly on a north-south axis; at its base there is a considerable deposit of sand. This shelf forms a natural catchment for silt eroded from the land, scoured from the bays, and drawn out to the deeper areas by the sea currents. The sand deposit was a focus of exploration for artifacts that might have made their way here from shallower areas over the centuries. None were found, but as modern garbage is tending to collect here, perhaps the deeper sand hides older material. We had no way of moving sand except for digging small test pits by hand.

Further out, at about 300 meters from shore, are the modern fishing grounds. At 13–14 meters of depth this area is regularly fished by boat and by divers armed with spear guns. Much of the ancient material in this area would long ago have been salvaged, either for use or as curiosities. Nevertheless, the team found a small number of pottery sherds over an area reaching from in front of Hotel Bay and south for a five hundred meters or more. Many of these sherds are small, encrusted with marine growth, and probably survived only as they are of no intrinsic or aesthetic value. Likewise, ancient anchors of stone, lead components, or iron would have been easily salvaged. A number of anchors, both stone and iron, were found, particularly to the north of Hotel Bay, but these were all modern as seen in the remains of synthetic ropes fastened to them.

Most of the pottery sherds appear to be Late Roman. A few are heavily eroded and cannot be dated. The most interesting piece was found far south in our search area and is part of the neck, shoulder, and handle of a small jug. The sherds do not, however, represent shipwrecks but are probably jettison from fishing boats. Pottery dropped and broken on boats was, and still is, simply tossed overboard to remove it from the boat. The finds indicate, however, that the modern fishing grounds are the same as those used in ancient times.

Fishermen everywhere are often archaeologist's best source of information about the sea and shipwrecks, and Lebanon is no exception. Local fishermen from Fadous related a story about a shipwreck in the area that occurred in the early 20th century. Pottery was brought up from the wreck decades ago, but the ship's large iron anchor still rests on the sea floor where it was found 20 years ago. Our attempt to locate this wreck site was unsuccessful, but the story illustrates the ease with which artifacts and

shipwrecks can be retrieved from the sea by the fishermen. Also, nearby in Batroun, an ancient Canaanite/Phoenician city, a fisherman in showed us amphoras from two wrecks. One of these jugs appears to be first-century Roman, while the other appeared to be a type common in the early first millennium B.C. Locations given for these wrecks were vague as the fisherman wanted to protect his resource, but as their positions were outside our search parameters, no attempt was made to locate the wrecks during the 2007 survey.

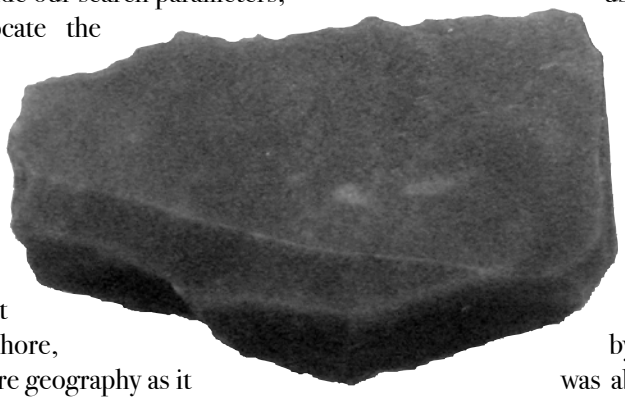


Fig. 8. *The stone knife blade (2.9 cm. long) found near the access point in Tell Bay (photo by Ralph Pedersen)*

Conclusions

The areas along the coast of the Tell at Fadous-Kfarabida contained no archaeological remains indicative of maritime activities related to the settlement on the tell. Examination of the shore, however, illuminates the seashore geography as it relates to the tell. The rock faces lining Hotel Bay and Wadi Bay clearly limit the use of these areas as landing points for boats in any period. The sheltered access point on the southern edge of Tell Bay indicates that this would likely have been the primary area in the early Bronze Age where tell inhabitants would launch fishing boats and return with their catch, if not actually export and import items on a small scale. The discovery of the knife blade in the shallows of the access point underscores the usefulness of this place for marine activities, and supports our determination that this bay is the most probable harborage and fishing zone for the inhabitants of Fadous-Kfarabida at the time. Small boats could easily have anchored here, if not have been drawn up on the shore. The adjacent rocks form a overhang and a barrier to the elements, creating a sheltered cove in which the boats could have stayed with a measure of safety in normal weather.

Similarly, the shores of the southern bay (area IV) could also have played a role in the marine aspect of the tell. For periods when the sea is calm enough, small canoe-like boats could have accessed the shore by simply running onto it. Although no hulls from the early Bronze Age have been found, simple dugouts and small planked boats could easily have been beached and launched from such a shore.

There have been shoreline changes in the eastern Mediterranean over the millennia. Recent studies indicate that there were at least two major tectonic uplifts in Lebanon: one approximately 3,000 years ago, and the other in the sixth century A.D. These have apparently resulted in the Early Bronze Age shoreline being at least a meter above the present sea level; the last major uplift fourteen centuries ago contributed 40–60 centimeters to the change. Despite these uplifts, both the beach of area IV and the access point of Tell Bay probably would have been just as useful as under present conditions.

As the survey area lay inside the supposed sailing routes between the ancient cities of Byblos and Batroun, there is a likelihood that shipwrecks from antiquity lay further out to sea in areas outside our research parameters. These areas should be examined in the future, possibly by multi-beam sonar. After the tell was abandoned after the Early Bronze Age, there would have been little reason for non-local boats to visit this section of the coast. Therefore, except for the rare foundering of a vessel in a storm, as happened in the early twentieth century, it is unlikely long-range ships of antiquity would have come to grief in the shallows of Tell Fadous-Kfarabida. Any local watercraft wrecked or abandoned in the area would have been quickly and easily salvaged, leaving little or no trace.◆

Further Reading

Bass, G.F. 1972. The Earliest Seafarers in the Mediterranean and the Near East, Bass, G.F. (ed.) *A History of Seafaring Based on Underwater Archaeology*, 12–36. New York: Walker and Company.

Casson, L. 1971. *Ships and Seamanship in the Ancient World*. Princeton: Princeton University Press.

Johnstone, P. 1980. *The Sea-craft of Prehistory*. London: Routledge & Kegan Paul.

Morhange, C., et al. 2006. 'Late Holocene relative sea-level changes in Lebanon, Eastern Mediterranean', *Marine Geology* 230: 99–114.

Pirazzoli, P.A. 1996. *Sea-Level Changes: The Last 20,000 Years*. Chicester, UK: John Wiley & Sons.

YUKON RIVER SURVEY 2007

John POLLACK and Robyn WOODWARD

The Yukon Territory is rich with history and sternwheelers dating back 110 years to the Klondike Gold Rush. Approximately 290 of these vessels operated between the mouth of the Yukon River near St. Michael Alaska, and Whitehorse, some 3300 kilometers upstream. Today some of these vessels remain as wrecks lying in the fast water of the river, but many others were pulled out every fall to avoid ice damage, and now sit abandoned in the forests along the river.

In 2005 John Pollack and Robyn Woodward organized a reconnaissance trip to the Thirty Mile section of the Yukon River. The Thirty Mile flows north out of Lake Laberge in a series of sharp, rocky meanders that claimed over 35 vessels between 1898 and 1936. Two earlier projects (Waddell, 1979; Easton 1986) worked sites to the south, yet they did not visit the Thirty Mile because of its remoteness.

Our first trip north operated under a Class 1 permit

Fig. 1. *A view of the* Evelyn *after the team hacked away surrounding vegetation (all images courtesy the authors)*

and covered 235 kilometers of the river by canoe. We visited and collected reconnaissance information from the sternwheelers *Casca 1*, the *Evelyn*, and the *Klondike*, as well as from two small gold dredges. Basic measurements, maps and photographs are contained in Pollack and Woodward (2006), and site inventory forms were filed with the Archaeological Survey of Canada.

In 2006 Pollack returned for a second reconnaissance trip with noted British Columbia historian Robert Turner and ship restorer Ken Butler. They visited the West Dawson site and inspected seven large, 100-110 year-old vessels of varying design lying on shore adjacent to the river. Additionally, low water allowed them to locate the *Gleaner* at Carcross and the *Clara Monarch* within the city limits of Whitehorse.

In the fall of 2006 the Yukon River Survey was adopted by INA and Pollack joined the institute as a research associate. A two-phase field effort was proposed for July 2007. The first phase utilized EPICSCAN, an expert LIDAR-scanning company from Oregon, to survey and document the construction and condition of the 1908 sternwheeler *Evelyn* on Shipyard Island. We then planned for a partial staff change and a second team to visit the West Dawson site. At this site we would perform the first survey of seven large sternwheelers, file site inventory forms, and discuss next steps for this complex site. Finally, if time allowed we would document the tiller-and-rudder systems on the *Evelyn*, the *Tyrell*, the *Julia B.*, the *Seattle No. 3*, and the *Schwatka*.

Figs. 2 and 3. *An aerial view of Shipyard Island in the Yukon River, between Dawson City and Whitehorse; below, a map of the area*

Phase One: The LIDAR Project on the Evelyn

The sternwheeler *Evelyn* lies on Shipyard Island, midstream in the Yukon River, approximately 90 kilometers from a road. This small island served both as a repair shipyard and a winter storage area. Typically the route between Dawson City and Whitehorse did not open until late May, when the last ice went out on Lake Laberge. The river is open several weeks earlier, but Lake Laberge is invariably the last obstacle to navigation. Hence Shipyard Island was well-positioned to stage freight and ships high on the river, where they could wait for the lake to open.

The *Evelyn* was abandoned on the island in the early 1920s. Unverified information compiled by Affleck (2000) notes the wooden-hulled sternwheeler was constructed in 1908 at St. Michael by Bratnobar for the Upper Tanana Trading Company, and initially operated under U.S. registration. Displacement was 508 tons gross and 397 tons registered with a length

of 39.6 meters (exclusive of paddlewheel), a beam of 8.7 meters, and a hull depth of 1.3 meters. The high pressure engines were built by the Clinton Novelty Iron Works in Iowa, had a bore of 30 centimeters and a stroke of 137 centimeters, and delivered 9.6 nominal horsepower.

The ship was sold to the Northern Navigation Company and subsequently wrecked in the Tanana River. The machinery was salvaged and taken to St. Michael where a new hull was built. In 1913 the vessel was converted to Canadian registry and in 1919 ownership was acquired by the British Yukon Navigation Co.. It was beached on Shipyard Island, the engines and one boiler removed to the Str. Keno in 1922, and the registration was formally cancelled in 1931.

The *Evelyn*'s hull, main (or freight) and boiler decks are largely intact. The mid- and aft portions of the upper deck and wheelhouse superstructure, have collapsed. The starboard boiler and stack remain in place along with minor machinery including a hand-operated water feed pump. The rudder-and-tiller assemblies are intact, and display a three-rudder, manual overhead tiller system utilizing two sets of gudgeons and rudder wells. The engines, the port boiler, and the port stack have been removed, and the paddlewheel axle lies nearby. Overall length of the massive axle is 802 centimeters with a diameter of 21 centimeters. The six-sided shaft is joined by a single splice—possibly a repair. The shaft runs through five cast iron hubs of 106 centimeters diameter, and each hub tied together 13 wooden arms (e.g. spokes). None of the arms, paddle buckets or iron circles remains.

Also present at the site are four windlasses and the shipyard ways along with the remains of a blacksmith shop and a steam bending box. The vessel is blocked up well above the high water, on the far side of the windlasses at the shipyard.

The hull of the *Evelyn* contains two stringers or streaks supporting continuous diagonal trusses incorporating metal tie-rods. These truss assemblies are offset 2.5 meters from the keel. There is also a central keelson with a solid bulkhead above it. This assembly rests on small cross timbers. The hull is 1.4 meters deep to the bottom of the bilge, and the chine displays cocked-hat construction. Two lines of hog-posts (or braces) were used to support a system of hog-chains and stiffen the hull, and support both the machinery and the paddlewheel. Knuckle chains also supported the sides of the vessel under the boilers.

Fig. 4. *LIDAR image, starboard side,* Evelyn

In the beginning of July 2007, a five-person crew and camp was transported to Shipyard Island by riverboat to conduct a detailed LIDAR survey of the *Evelyn*. As a first step, a half-day was spent cutting all brush and coniferous regeneration from around the perimeter of the vessel to provide clear lines of sight from the LIDAR stations.

The LIDAR survey was utilized a Leica Scanstation powered by a battery and a Honda EU2000 inverter generator. The LIDAR unit is a sophisticated, robotic total station equipped with a pulse laser, and it is capable of collecting millions of data points per hour under

ideal conditions. Prism targets are not required and the pulse laser permits the collection of data from physically inaccessible areas. The resultant individual data clouds obtained from each setup point were merged into a single, 3D data cloud.

The Leica unit was owned and operated by Carlos Velazquez and Doug Devine of EPICS-CAN (Oregon), who participated in the project as volunteers. In the course of five days, more than 46 LIDAR stations were established around, on, and within the vessel. Stations were established on the main and saloon decks, and in the bilges. The general scanning parameters made a shot every five millimeters at a distance of 15 meters, such that over 160 million data points were collected. While we would not have taken as many data points with a conventional survey and a total station, had we done so the collection of this much survey-grade data would have required 1300 crew-years.

The result of this project may be the most complete model of a vessel ever produced in situ. As seen in the attached scans, LIDAR has captured every detail of the vessel, from the individual components of each frame station, to the position of the knuckle chains below the boilers, to the strands of oakum hanging below the freight deck planking into the bilges. More importantly, the 3D model can be rotated, sliced, and used to produce 2D images for any number of purposes related to describing the general construction of the *Evelyn*, or to highlight the details of its systems. A paper describing the project is planned for the Society of Historical Archaeology's online technical series.

Phase Two: Initial Documentation of the Vessels at West Dawson

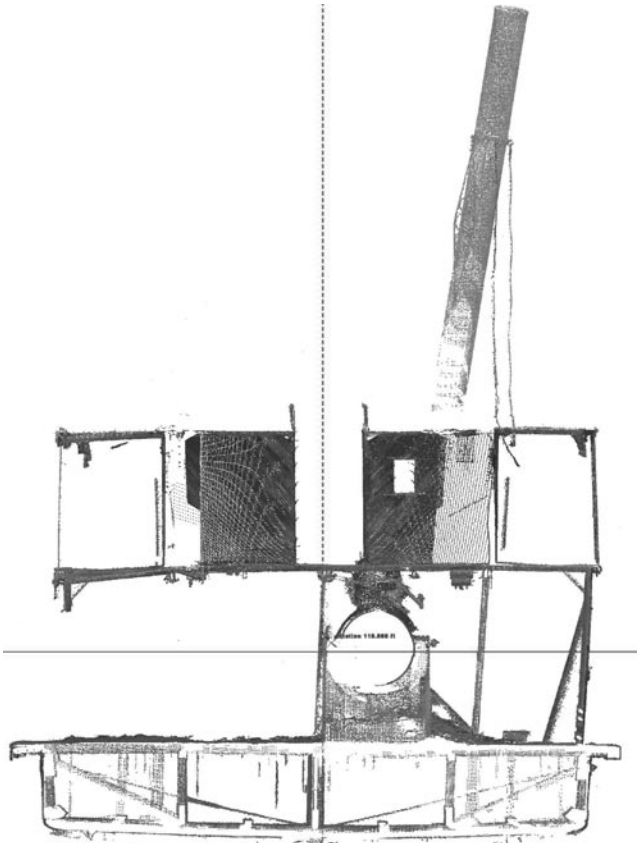
In 2006 we learned the largest intact collection of sternwheelers in Canada, and perhaps the western US, lay undocumented at West Dawson. Our priorities for 2007 field work were to gather as much field information as possible on these seven large vessels, prepare the site inventory forms that would incorporate them into the Canadian national inventory, and size them up for future work. We also hoped to gather measurements

Fig 5. *Setting up a reference point for the scan station*

on the several types of intact tiller-and-rudder systems.

The site was situated 550 kilometers north of Whitehorse, and it took us two days to change crews for the second phase and drive north. The site is opposite and slightly downriver of Dawson City. From a large campsite it was a 350-meter hike north to the first cluster of four sternwheelers. Here three vessels lay abreast of each other, with the *Julia B.* being right next to the water, followed by the *Seattle No. 3* and the *Schwatka*, as one moves inshore. South of these three vessels is a fourth, unidentified sternwheeler.

In the group of three vessels lying abreast, the *Julia B.* is a 48.4-meter-long wooden-hulled vessel built in 1908 that has been heavily damaged by ice on the port side. Engine components, parts of the port smokestack, chainstays, keelsons and stringers, and a ventilation funnel litter the shore of the Yukon River and lie in shallow water. Her hull is heavily built with multiple longitudinal streak/bulkhead assemblies, four streak/truss engine supports, and large transverse carriers under the boilers. The superstructure is partially collapsed forward of the engine room which, while upright, has a pronounced lean. The machinery, boiler and engines are substantially intact. Decking and deck beams are completely intact in the remaining portions of the hull, and it is possible to access the entire hull thru various hatches. Twin boilers are still on their mountings and transverse carriers, and the starboard one has breeching and stack



Figs. 6 and 7. *LIDAR cross-section of boiler area,* Evelyn *(inversed); remains of the paddle wheels of the* Schwatka

intact. The starboard engine is partially disassembled. Cylinder, valves, wipers and levers, connecting rods, and pitman arm are present. The port engine is less complete. The sternwheel axle with five flanges, and it is still attached to the starboard pillow block and pitman arm. Most of the arms are missing from the flanges as are the majority of the iron circles, and all of the buckets are gone. The vessel has a complete tiller-and-rudder system with three manual, overhead tillers affixed to sternposts via sets of gudgeons and long pins. Rudders are present but lie deeply buried in sand. An unusual mechanical system—possibly a shock absorber—is attached to a truss and lies disarticulated on top of the tiller arms.

The *Seattle No. 3* and the *Schwatka* are 45.7 to 44.5-meter-long wooden-hulled vessels built in 1898. They both display kingposts on large transverse carriers, heavily reinforced bows, and the hulls are intact. Superstructure has collapsed except for aft crews quarters and steering compartment of the *Seattle No. 3* . Engine components are absent on the *Seattle No. 3* , but present on the *Schwatka*. Both ships have intact single boilers, and the *Schwatka* has a complete (except for the buckets) sternwheel assembly. The *Seattle No. 3* contains a unique but incomplete four-tiller and roller- steering system with the tiller arms riding only slightly above the main (freight) deck. Iron-sheathed wooden semicircles for tiller bearings are affixed to the freight deck, but the tillers, rudders and rudder posts are absent. The *Schwatka* contained a similar system consisting of four rudders and rudder posts on pillow blocks. On this vessel the tillers are located in the hold, below the main (freight) deck where we found an almost completely intact system of blocks, tiller arms, rollers, and linkages.

The last vessel in the first cluster remains unidentified. It has a measured length of 43.3 meters, a wooden hull, rudder posts that turned on pillow blocks, three streak/solid bulkhead assemblies, and four streak/truss assemblies supporting the engines. No superstructure remains, and only the aft five meters of the main deck and deck beams are in place. All machinery, engines, boiler, and stack are absent. A substantial portion of the bottom planking and floors are missing amidships yet all frames and clamps remain. The sternwheel, rudders and tillers, hog-posts and chains are absent, although two cylinder timbers are visible.

Fig. 8. *Superstructure collapse of the 110-year-old* Seattle No. 3.

A second cluster of vessels is located another 180 meters downriver and approximately 45 meters west of the shore. This cluster consists of *Mary F. Graff*, the *Victorian*, and the *Tyrell*.

The *Mary F. Graff* is a wooden-hulled vessel built in 1898. It contains a substantial component of its engines and ancillary machinery, plus a complex three-boiler battery. The tillers, rudders and sternwheel are missing. All superstructure is missing and the hull has been burned aft of boilers except for the chine, outer frames, clamps and upper hull planking. No deck beams or planking remain except at the bow where they have collapsed into the hold. A central hogpost was noted forward of the boiler, yet there was no evidence of a corresponding transverse carrier. Both engines, along with some ancillary machinery and decorative control arms, lie in an area of the hull that was almost completely consumed by fire. The "pudding" or decorative stack top of this vessel, lies nearby. A steam-powered Hyde capstan built in Bath, Maine, lies on the collapsed freight deck near the bow. One keelson and two streaks were noted and appear undersized. Each support truss-built, longitudinal bulkheads.

The *Victorian* is another wooden-hulled 1898 vessel. The hull is open to the sky except for the forward 12 meters of bow, and evidence of fire can be seen on the outside of the hull, aft on the port side. Superstructure and machinery are removed. Decking and deck beams are removed/destroyed except for the forward 12 meters of the bow. The sternwheel is absent and no large machinery such as engines, pitman arms, boilers, or auxiliary team pumps are present. Identification is certain given the presence of a faint name stencilled on the bow. The port cylinder beam and port rudder show signs of repair, possibly as a result of damage incurred during a grounding while being towed from the Stikine to Alaska. The most substantive features of the vessel are a complete tiller and rudder system at the stern, where three manual, overhead tillers are fixed with pairs of gudgeons and long pins, and rest in wells between the transom and false transom.

The *Tyrell* is a 43.4-meter composite steel-wooden hulled vessel built in 1898. This is the sole example of a composite-hulled vessel at West Dawson. The ship displays steel sides and chines, steel bulkheads, and steel deck beams. These steel components are completely intact. The bottom is planked with wood. Thirteen separate compartments were noted, many of which were isolated from the remainder of the hold.

Figs. 9 and 10. *Above, journalist Koppel points to tiller-roller bearing surfaces on the* Seattle No. 3, *possibly from connecting linkages; below, Koepnick with transverse carrier and toppled kingpost,* Seattle No. 3

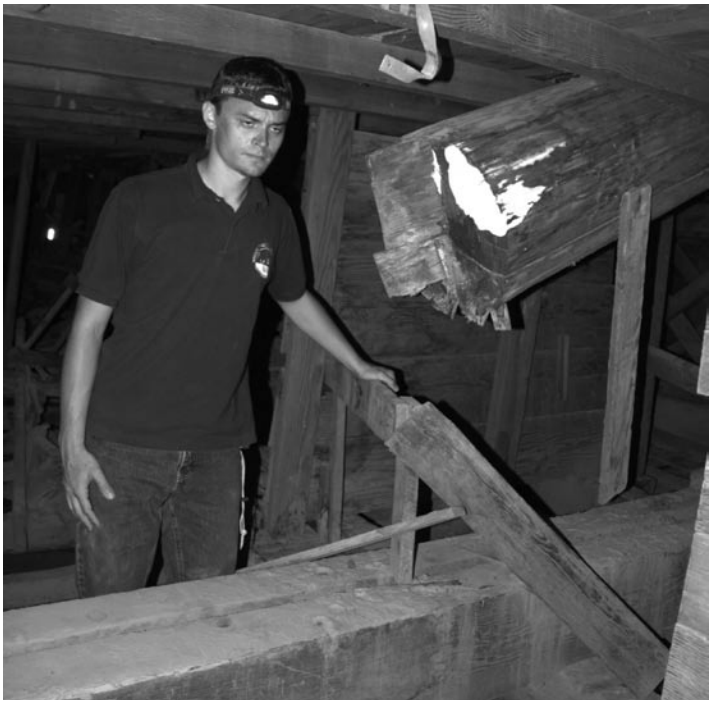


Fig. 11. *Woodward with triple tillers,* Victorian

The remaining machinery includes a condenser in the hold, and a single steam cylinder and monkey rudder post lying on the freight deck. No hog posts or chains were noted and the vessel's wooden superstructure is completely missing above the main (freight) deck. Tillers, rudders, and paddle wheel are missing. The rudder posts turned on pillow blocks. One of two cylinder timbers remains and of the engine machinery, a single one engine cylinder (40.6 centimeter diameter by 216 centimeters) lies disassembled on the main (freight) deck.

This brief overview cannot begin to do justice to the complexity and richness of the West Dawson site. This site is an unstudied, outdoor museum of late nineteenth century construction, and while remote, it is a relatively safe and efficient site to conduct comparative studies on hull construction and ships' mechanical systems. Most hull and many engine, boiler, and steering components are substantially intact. We expect to work on this site for a number of years to come.

The 2007 field season can be summarized as follows:
• A state-of-the-art LIDAR survey was conducted on the *Evelyn*. James Delgado believes the Shipyard Island work is one of the largest, in-situ LIDAR project yet conducted in nautical archaeology.
• Seven vessels at the West Dawson site were documented, and added to the territorial and national inventories. We can now say conclusively that the Yukon sternwheelers were anything but uniform in construction method and design. The differences among vessels support the theory some archaic and novel designs were used in the rush to build 110 sternwheelers on the West Coast in 1898.

• Valuable data and insights were obtained concerning the types of tiller-and-rudder systems used on the northern sternwheelers. This component study proved most worthwhile in terms of its insights.

The amount of information generated in the 2005 and 2007 field seasons is such that several publications and presentations are now feasible. The first publication—an overview of the 20 +/- sternwheeler sites—is underway for submission to the Yukon Territorial Government, and we hope to have this document plus an SHA on-line technical publication on the LIDAR project, in print by early 2009. Field work for June 2008 will consist of further reconnaissance work on the Thirty Mile Section of the River, and—if water conditions permit—a detailed mapping project on the wreck of the Klondike. No plans have yet been made for 2009 field work, however, the West Dawson site offers many possibilities for component studies, and it is the logical place to continue the effort at low cost.◆

Acknowledgements

The 2007 field crew included Doug Davidge (Whitehorse, British Columbia), Doug Devine (Oregon), Sam Koepnick (INA, Texas A&M), Tom Koppell (Archaeology Magazine), John Pollack (INA, British Columbia), Carlos Velazquez (Oregon), and Robyn Woodward (INA, Vancouver). Our sincere thanks to all of you.

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Tom Koppel, contract writer for *Archaeology* magazine, worked with us at West Dawson and in his thorough article has accurately captured the urgency of the work in the North.

Finally, James Delgado, CEO and president of INA, has fostered this project from the beginning. Likewise Jeff Hunston (Manager, Heritage Resources Unit, Yukon Territorial Government) has consistently provided insight, advice and support during the permitting process.

Fig. 12. *3-boiler battery,* Mary F. Graff

References

Affleck, E. L., 2000. *A century of paddle-wheelers in the Pacific Northwest, the Yukon and Alaska.* Alexander Nicolls Press #208 2250 S.E. Marine Drive, Vancouver, B.C.

Easton, N.A. 1986. *Yukon Underwater Diving Association Heritage Resources Inventory—Final Report.* File report for the Heritage Branch, Yukon Government Whitehorse.

Pollack, J.C. and R. P. Woodward. 2006. *A Reconnaissance Survey of the Yukon River between Lake Laberge and Carmacks.* File report for the Heritage Branch, Yukon Government Whitehorse.

Pollack, J.C.., R.P. Woodward, S. Koepnick, C. Velazquez, D. Devine and D. Davidge. 2008. *The Yukon River Survey, 2007.* File report for the Heritage Branch, Yukon Government Whitehorse.

Waddell, Peter J.A. 1979. *The 1978 Yukon Marine Archaeology Survey.* Archaeological Research Division, File report for the National Historic Parks and Sites Branch, Ottawa.

PHOENICIANS IN THE WEST

The Ancient Shipwreck Site of Bajo de la Campana, Spain

Mark E. POLZER and Juan PINEDO REYES

The Phoenicians—their name conjures up images of shrewd merchants who traversed the far reaches of the ancient known world in ships searching for raw materials sources and markets for their goods. Yet we know relatively little about these enigmatic people from the Levant, what today is roughly Lebanon? A large part of the problem is the limited source material we have to work with. The Phoenicians themselves left few written records to document their lives, political organizations, culture, and the great sea voyages of trade and colonization for which they are so renowned. Most of our knowledge of these things comes from Greek and Roman historians writing many centuries later. Unfortunately, the Greeks and Romans were often bitter adversaries of the Phoenicians and so much of their works are tainted with legend and bias. The Assyrian annals and Hebrew Scriptures provide the only contemporary written sources for the Phoenicians, but these only record events in Biblical lands and the eastern Mediterranean. Testimony of Phoenician activities in the west are nearly non-existent.

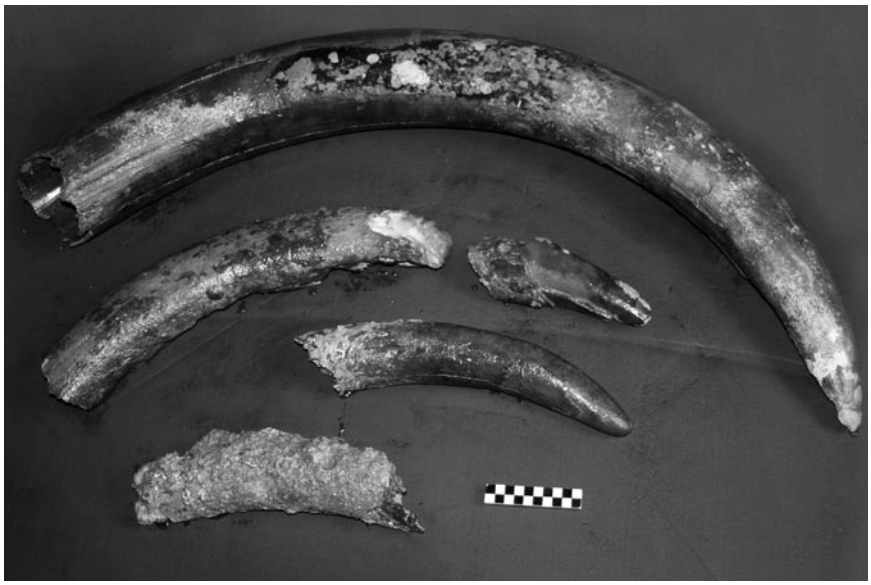


Fig. 1. *Elephant tusks recovered during the survey (photo by Mark Polzer)*

In recent decades, Phoenician archaeology has made great strides in unlocking the secrets of Phoenician activity throughout the Mediterranean and beyond, though it still remains far behind Greek and Roman studies. INA has played a significant role in this regard. Founder George Bass' ground-breaking underwater excavation of the twelfth-century B.C. wreck at Cape Gelidonya and INA's landmark discovery and study of the Late Bronze Age shipwreck at Uluburun have rewritten the early history of these people and trade in the eastern Mediterranean. Historians generally refer to the coastal inhabitants of Syria-Palestine during the Bronze Age as Canaanites, and reserve the term Phoenician for the same peoples of the Iron Age, or the first millennium B.C. From around the end of the ninth century B.C., constrained by geopolitical circumstances in their homeland, the Phoenicians—especially from the city of Tyre—set upon a period of great exploration and colonization directed westward, much of it driven by commercial interests. Perhaps the most famous and seminal event of this migration was the founding of Carthage on the north African coast, in what is today Tunisia. Carthage would grow in power and wealth and assume commercial and maritime dominance in the western Mediterranean. This position would eventually bring it into direct conflict with another burgeoning power, Rome, and lead ultimately to the city's demise.

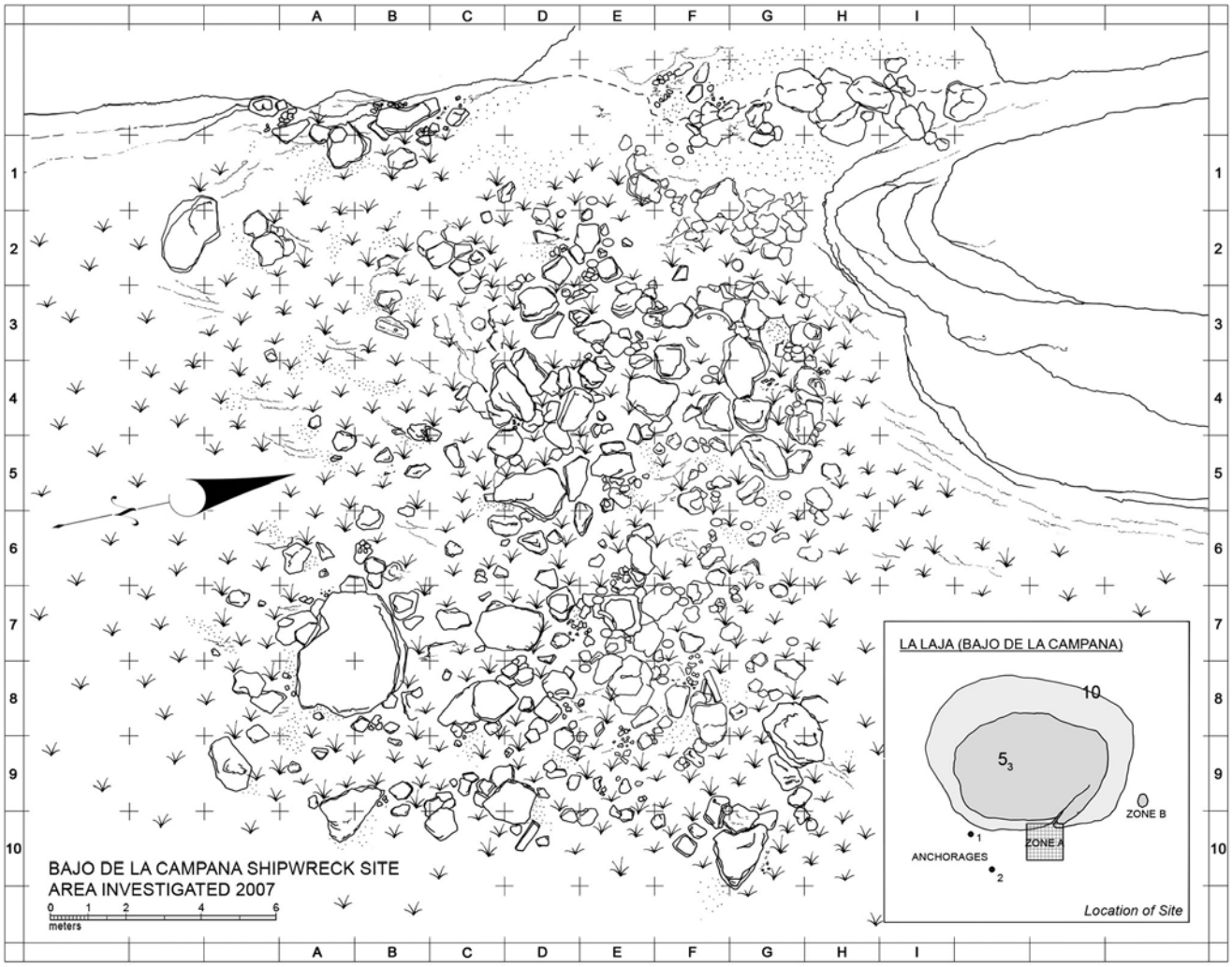
Phoenician colonization of the Iberian peninsula and exploitation of its metal deposits (especially those of silver, tin, and lead) and agricultural resources can be traced by archaeological evidence to this same period, between the late ninth and seventh centuries B.C. After the Phoenician homeland fell under Babylonian domination in the mid-sixth century B.C., Carthage assumed military and political hegemony over the Phoenician colonies and mercantile interests in the west. Historians mark this transition by referring to the western Phoenicians after this time as Punic, which comes from the Latin *punicas*, a transcription of the Greek name *phoinix* from which we derive our name Phoenicia.

INA's research in this field continues now with the investigation of a probable Phoenician shipwreck at a

submerged site in southeastern Spain known as Bajo de la Campana ("Shallows of the Bell"). The site is located in the Mar Menor region of Murcia, northeast of Cartagena. It first came to light in the late 1950s and 1960s when salvage divers, dynamiting modern shipwrecks for scrap metal, began finding antiquities on the seabed. Subsequent investigations of the site, including INA's survey in the summer of 2007, have revealed evidence for at least three ancient wrecks. The oldest material recovered so far includes western Phoenician amphoras, bowls, and plates that date to the late seventh or early sixth centuries B.C., during the period of growing Carthaginian influence in the region. The ship was also transporting an assortment of raw materials including tin ingots possibly from Galicia, on the northern Atlantic coast of Iberia; silver-bearing lead ore known as galena, likely mined locally around Cartagena; lumps of raw amber; pine cones; and ivory from north Africa. INA's investigation found four elephant tusks, including one remarkable example measuring over a meter in length and bearing a Phoenician inscription at its root end. Recovered from beneath the tusk was a double-ended wooden comb decorated with incised horizontal and vertical lines.

From the other two wrecks the team found Punic amphoras from Ibiza and black-glazed ceramic wares from Italy that date to the second century B.C., around the time that Rome completed the final destruction of its centuries-old nemesis Carthage; and Roman amphoras used to carry fish sauce, wine, and olive oil that date to the first century A.D., when Cartagena and the surrounding region enjoyed great prosperity as part of the Roman empire. The survey also recovered several copper nails, lead sheathing, and ballast stones from one or more of the ships' hulls.

Fig. 2. *Map of southeastern Spain showing the location of Bajo de la Campana (map by Mark Polzer)*



Figs. 3. and 4. *Plan of the Phoenician/Punic shipwrecks site, with the wall of the Bajo, the "cave," and the crevasse forming the upper (western) extent of the site; a piece of Campana A ware from southern Italy (2nd century B.C.), was part of the cargo from the Punic shipwreck. (Plan and photo by Mark Polzer)*

INA will begin a thorough excavation and study of the Phoenician wreck in 2008. Not only will this be the first such undertaking for INA in the western Mediterranean, but it will be the first wreck of a seagoing Phoenician ship to be excavated and studied. As such, the project is posed to provide exciting new archaeological evidence for Phoenician activity in Iberia and trade in the western Mediterranean. The cargo materials known already to have been on board—tin from the Atlantic, elephant ivory from Africa, amber from the Baltic, and lead from southeastern Iberia—have the potential to illuminate far-flung trade and production pat-

terns in the Archaic Mediterranean world, much as the Uluburun shipwreck material did for the Bronze Age.

INA's venture in Spain marks a new chapter in its illustrious history. Most of INA's work in the Mediterranean has been focused on the east, particularly in Turkish waters. In 1970, an INA team directed by David Owen excavated the looted wreckage of a late fifth-century B.C. ship at Porticello, off the coast of southern Italy in the Straits of Messina (*The INA Quarterly* 2:1-4). Now, with the commencement of the Bajo de la Campana shipwrecks excavation, INA is extending the geographical boundary of its work to the westernmost reaches of the Mediterranean. None of this would have been possible without the interest and enthusiastic support of Spain's Ministry of Culture and, more specifically, Director Rafael Azuar and his staff at the National Museum of Maritime Archaeology (MNAM) in Cartagena. The excavation of the site is a cooperative effort between INA, MNAN, and its associated National Center for Underwater Archaeological Research (CNIAS). The MNAM-CNIAS has a long history of archaeological investigation and cultural management of the underwater patrimony of southeastern Spain, but has not undertaken an underwater excavation since 1995. The new partnership with INA is one of mutual benefit. The Museum is providing storage and conservation of the artifactual material from the excavation as well as contributing financial and logistical support to the project. INA, in turn, will provide fieldwork and research expertise to train the Museum's archaeological staff. The project will also generate positive publicity and collection material for the new museum that the Ministry is building in Cartagena. The collaboration will open new possibilities for research to INA and students of the Nautical Archaeology Program at Texas A&M University, while also training Spain's next generation of maritime archaeologists through field school opportunities. With such promise for the future, it is a true honor and privilege to have been invited by the Ministry to work with their institutions to help move maritime archaeology forward in Spain.◆

Fig. 5 *Co-director Juan Pinedo searches a grid sector in the Phoenician area after two tusks were removed from it (photo by Mark Polzer).*

Acknowledgements

It is with deep gratitude that we recognize the enthusiastic support of the Region of Murcia, who granted us the archaeological and marine operating permits to conduct the investigation, and of the Ministry of Culture of Spain. Financial support for the initial season of investigation was provided by a generous grant from the Spain-USA Foundation, thanks in large part to INA General Counsel Jim Goold and Jorge Sobredo Galanes, Minister of Cultural Affairs at the Spanish Embassy. Additional funding was provided by INA director John De Lapa and the Waitt Family Foundation. The Institute of Nautical Archaeology and Texas A&M University supported our initial development efforts in 2006, which enabled the project and collaboration to materialize. The stalwart core of our team this summer consisted of MNAM-CNIAS boat captain and diving safety officer Emilio Peñuelas González and Nautical Archaeology Program students Carlos Cabrera and Piotr Bojakowski, each of whom participated for the entire six weeks of the project. Additional team members included Nautical Archaeology Program doctoral candidate Wendy van Duivenvoorde from the Western Australia Maritime Museum; Eduardo Roa Brynildsen, an intern at the Vasa Museum in Stockholm; Christin Heamägi, also from the Vasa Museum and an incoming graduate student of the Maritime Archaeology Program

at the University of Southampton; archaeology graduate Miguel Lirio Diaz; archaeologist Josué Mata Mora; and professional diver Joaquin Carrasco Burguete. The administration and staff at the MNAM-CNIAS proved to be excellent partners in this endeavor. Director Rafael Azuar Ruiz, curator María Ángeles Pérez Bonet, and head archaeologist Rocío Castillo Belinchon all supported the project with personnel, equipment, and resources; staff archaeologists José Rodriguez Iborra, Ana Miñano, and David Munuera Navarro rotated time with us in the field; head conservator Milagros Buendía Ortuño and her staff are overseeing the conservation and storage of the raised artifacts; and Juan González provided photographic services. Luis Manzano Diaz, director of the Puerto Tomás Maestre marina in La Manga, kindly provided a slip for us to dock our boat and allowed us to set a storage container on site in which to keep our dive gear and other supplies. And finally, Annunziata Ponce Albendea volunteered so much of her time to the project as logistical coordinator, interpreter, and general liaison in Spain; our work would have been so much more difficult without her.

Suggested reading

Aubet, M. E. 2001. *The Phoenicians and the West: Politics, Colonies, and Trade*. Cambridge University Press.

Mas García, J. 1985. El Polígono Submarino de Cabo de Palos. In *Arqueología Submarina: VI Congreso Internacional de Arqueología Submarina, Cartagena 1982*. Ministerio de Cultura, Dirección General de Bellas Artes y Archivos, Subdirección General de Arqueología y Etnografía.

Roldán Bernal, B., M. Martín Camino, and A. Pérez Bonet. 1995. El yacimiento submarino del Bajo de la Campana (Cartagena, Murcia): catálogo y estudio de los materiales arqueológicos. *Cuadernos de arqueología marítima* 3:11-61.

The 2007 Bajo de la Campana team, from left: Mark Polzer, Miguel Lirio Diaz, Ana Miñano Domínguez, Emilio Peñuelas González, José Antonio Moya, Carlos Cabrera, Juan Pinedo Reyes, Joaquin Carrasco Burguete, and David Munuera Navarro; not pictured: Piotr Bojakowski, Wendy van Duivenvoorde, Christin Heamägi, Eduardo Roa Brynildsen, José Rodriguez Iborra, and Josué Mata Mora (photo by Piotr Bojakowski)