

## **THE MA'AGAN MIKHAEL ANCIENT SHIP**

### **THE RECOVERY OF A 2400 YEAR OLD MERCHANTMAN**

by

**Dr. Elisha Linder**

#### **Summary**

Kibbutz Maagan Mikhael is located 35 km. south of Haifa along the Mediterranean coast of Israel. The ship was found 70 meters off shore in shallow water 1.8 meters deep and buried under a layer of sand, 1.5 meters thick. It was identified as a sailing merchantman with a displacement of about 23 tons that survived in an outstanding state of preservation, with all the lower portion of the hull remaining intact. C14 and ceramic analysis date the wreck to the end of the fifth century, BCE. Among the finds were thirteen tons of stones and rocks, seventy ceramic wares, food remnants, ropes, carpenter's tools and a one-arm wooden anchor. The ship, her finds as well as the construction techniques, arouse much interest among nautical archaeologists from all over the world.

The ship was dismantled underwater and the pieces were moved to conservation laboratories at the University of Haifa. After seven years of treatment, the conserved timbers were transferred to a museum, a wing of the Hecht Archaeological museum, especially constructed for the ship on the university campus. The meticulous reassembly process which has been undertaken is similar to the construction of a huge 'jigsaw puzzle' and has incorporated intensive investigation and research at each stage.

Our volume describes the ship's sailing venture, nautical archaeological comparative studies, the underwater excavation, analysis of the finds and construction methods of the ship.

The Maagan Mikhael Ship is a unique find: the amount of timbers that survived is vast; it includes the entire bottom of the hull, up to and over the first wale. The keel is completely intact as well as the stem posts. Portions of eleven strakes survived to starboard and seven to port. Fourteen frames, the mast step and a few additional internal components were uncovered as well. Their state of preservation was excellent. Thus our thorough study of the ship provides updated information constantly. The abundance of artifacts that were found, both in number and quality, enables numerous scholars to be involved in different aspects of the research. Thus, this ship has become the subject of continuous research. In addition, several components of the ship are the subject for several master theses and one Ph.D.

dissertation of our students. Thus, information culled from the ship has enriched our knowledge concerning maritime activity of the first millenium BCE.

Since all the ship's contents have been retrieved from the seabed and the hull dismantled underwater, scholars have had the unique opportunity of access and have been enabled to study every minute detail of the ship's construction. In addition, the conservation method was chosen by us because of its reversibility quality. It gives us the opportunity to analyze the wood as it was years ago preceding conservation. All the artifacts were retrieved from the ship prior to the treatment of the hull, making them accessible for continuous study. They are all stored at the museum at the University of Haifa. The timbers of the ship have now been completely reassembled and are on exhibition.

#### **THE DISCOVERY AND PRELIMINARY EXPLORATION OF THE SITE**

Many important archaeological discoveries are made by chance and not as an outcome of planned research. Often, unexpectedly, artifacts are found in places which had been visited more than once by professionals and laymen alike. Such was the case with the Ma'agan Mikheal Ship which was a casual discovery laden with luck and a dramatic touch of coincidence. The ship was found offshore Kibbutz Ma'agan Mikhael, situated 35 km south of Haifa, where 30 years earlier marine archaeology in Israel began and where the newly created Undersea Exploration Society of Israel (UESI) was first based. Oddly enough, when compared with the wealth of antiquities revealed in the waters of the ancient harbor cities of Dor to the north and Caesarea to the south, this stretch of sandy sea bottom had not yet yielded any valuable archaeological finds, even though the sea along this coast had served as a training area for divers who spent many hours underwater practicing search and survey techniques.

In the fall of 1985, Ami Eshel, a native of the kibbutz and a former member of the UESI, returned late one afternoon from a dive along the coast. He reported having come across a pile of large stones protruding from the sand, among which were pottery shards and several pieces of wood. It was at a location some 70

m. offshore in a depth of less than 2,5m. of water. The stones were not a type familiar to the region and the pottery was clearly not modern. Thus it occurred to him that he may have stumbled upon the relics of an historic shipwreck. Following customary procedures, he informed the representative of the Isreal Department of Antiquities and Museums (IDAM)(1) of his finds.

PRELIMINARY investigations of the site were conducted the following day by S. Wachsmann and K. Raveh (2). More timber and ceramics were found, including an oil lamp and some storage jar handles. After close inspection these were initially dated to the end of the 6<sup>th</sup> or early 5<sup>th</sup> centuries BCE, which obviously caused much excitement and called for more thorough analysis. The exact location was marked with small buoys floating under the water surface and the exposed area covered up with sandbags to protect the site and prevent disclosure. Triangulation measurements were taken from a fixed point on the shore and drawn on a provisional map.

Further examination of the finds had to be postponed to the springtime, following the winter storms, when the sea would be calm enough to permit intervention without endangering the relics. Also there was the possibility that the delicate equilibrium which had existed between natural forces and the artifacts for a period of what subsequently

turned out to be 2400 years, might be disturbed. A permit to more fully explore the site was granted to the Leon Recanati Center for Maritime Studies of the University of Haifa (3). In the spring of 1986, A. Raban joined me in conducting test soundings around the site to determine the nature and extent of the remains buried under the sand. The amount of timber revealed left little doubt as to their belonging to a hull structure built with clearly defined long strakes. Pegged mortise and tenon joints were observed, a shipbuilding technique which gave further credence as to the antiquity of the discovery. Additional investigation prior to a full scale excavation was called for.

This was carried out in spring of 1987 by the same team assisted by several students from Haifa University's Department of Maritime Civilizations. A test trench was later dug along the northern limits of the site. The information obtained confirmed that lying below a thick layer of rocks were sizable remains of hull timbers in a remarkable state of preservation despite the odds posed against it by the potential action of destructive natural forces and marine borers. Credit for this was given to the anaerobic environment in which the timbers had been encased apparently for millennia.

THE HULL showed no signs of structural collapse caused either by its own weight or that from the cargo and stones which added pressure from inside. Nor did the heavy layer of sediment which had completely concealed the ship produce any substantial damage. On the contrary – the relatively short interval which must have elapsed from the time the ship was disabled and left stranded on the beach and its complete covering over by sand afterwards most likely had prevented infestation by teredo worms or barnacles and left little time for human interference. This may explain why, despite this readily accessible target so close to the shoreline, some of the smaller artifacts were left intact and in place. Also it appeared that none of

the Hull's structure had been dismantled for secondary use in shipbuilding. We assumed that the mast, sail and steering oars had either disintegrated or been washed away.

THE CHAIN OF reefs and a small island, which run parallel to the coast some 250 m. westward, affect the currents and sediments that flow in this particular area and have a direct impact on the local coastal processes. Bathymetric surveys which were earlier conducted offshore to the north of the site indicated the presence of two sand bars running parallel to the shoreline. These changed shape and location during different seasons of the year. In October, the inner bar under which the ship was buried, was found about 100 m. from the shoreline with a crest at a height of 2.0 m (5). The dynamics of the sand movement and formation of sand bars could explain the speedy covering of the ship when it foundered or was beached. We then speculated that even if the ship had been partially exposed in the past, the site must have been immediately covered up again.

Recent studies in the dynamics of sand movement along the Mediterranean coast of Israel have reconfirmed that in the past, sand which originated in the Nile River moved counter-clockwise feeding the beaches as far north as Akko (6). However, since the construction of the Aswan High Dam in 1965 together with the intrusion of man-made structures (7) and intensive sand mining for building purposes, great quantities of sand had been removed. The latter process was a phenomenon which affected the coastal strip all along the north of our site. A result of this was a rich harvest of shallow water archaeological discoveries in recent years and may have been directly responsible for the partial exposure of the ship site (8). All the above led to the conclusion that after the site was covered it was exposed just once for a short time during the 2400 year period following its demise-now, intentionally, and by us!

The results of the preliminary investigations were promising enough to justify the planning of a full scale excavation of the ship and whatever belonged to it. The first concern was adequate funding to cover all phases of the project: excavation, retrieval, thorough recording and conservation of the finds, basic research into the shipbuilding technique and relevant historical information – origin, routing, destination, etc., publication of the results, and the ship's eventual display to the general public in a museum.

At that time, Sir Anthony Jacobs from London (now Lord Jacobs and former Chairman of the Board of Governors of the University), was informed of the discovery. An avid sailor, with an interest in sailing ships past and present, he became enchanted by this unique find and its importance for the study of seafaring in the first millennium BCE, accepted full sponsorship of the research project. Once an expense budget was prepared and the material needs were guaranteed, a request for a formal permit of the excavation was submitted to the Department of Antiquities and Museums. It was granted soon after.

#### **Forming the research team**

THE NEXT STEP was to assemble a team of trained nautical archaeologists. This was not a simple task since maritime archaeology in Israel had been primarily engaged in surveys and excavations of historical harbors like Caesarea, Akko, Atlit and others. We approached Prof. J.R. Steffy (9), a specialist in ancient ship construction, who in the past had advised on the Kyrenia Ship hull excavation in Cyprus, to suggest a suitable candidate to conduct the excavation. He warmly recommended Jay Rosloff, his former student. Jay was well equipped with both the theoretical knowledge of ship building in antiquity and had the practical experience in underwater excavations and ship hull reconstruction, gained while working on excavations in Turkey (10). He

was offered the position of Field Director, moved to Israel with his wife Beth, and settled temporarily at Ma'agan Mikhael.

JAY ACQUAINTED himself immediately with the site and carried out additional soundings and limited trial excavations, mainly to define the outer limits of the archaeological finds. Coring, by means of a water-jet probe, was introduced to determine the extent of the archaeological finds scattered around the site.

The data which was gathered was now sufficient to set a date for the first season of excavation for the autumn of 1988. Selecting the expedition team was the next step. The research team was first drawn from the faculty, professional staff and students of the Department of Maritime Civilizations of the University of Haifa and later joined by volunteer divers from the kibbutz and former members of the UESI. Rosloff was keen to have some of his close associates join the expedition and contribute their knowledge gained from experience in similar excavations in other areas of the Mediterranean. The permanent staff of trained maritime archaeologists also included artists, technicians, draftspeople, photographers, recorders, etc. They were:

Elisha Linder: Project Director;  
Haifa University

Jay Rosloff: Field Director;  
Texas A&M University

Mike Udell: Assistant Field Director;  
MA Student (at time of excavation);  
Haifa University

J. Lyon: Assistant Field Director;  
MA Student (at time of excavation);  
Texas A&M University

Stephen Breitstein: Chief Operations Officer;

Haifa University  
Yossi Tur-Caspa: Geo-Technician;  
Haifa University

Eve Black: Secretary, Registrar;  
MA Student (at time of  
excavation);  
Haifa University

Yaacov Kahanov: Quartermaster;  
MA Student (at time of  
excavation);  
Haifa University

Netia Piercy: Artist. Institute of Nautical  
Archaeology;  
Texas A&M University in  
Bodrum, Turkey

Danny Siyon: Stills Photographer;  
Haifa University

Itamar Grinberg: Video Photographer;  
Independent

Judy Scheuer: Assistant Photographer;  
New York

Yitzhak Dagan: Administrator;  
Haifa University

These were joined by volunteers from the US, Canada, UK, Switzerland, Italy and New Zealand, all united by their love of the sea and the history it holds. The list includes: Anthony Abry, Na'ama Bahat, Jack Bateman, Lucy Blue, Modi Bracha, Christopher Campbell, Rachel Crausaz, Moshe Dotan, Shimon Gil, Michael Halpern, Avraham Hasidim, Doron Kipnis, Roni Levi, Oren Linder, Sigal Namer, Anna Nichols, Shimon Rothenberg, Tami Shabi, and Sam Turner.

AUXILIARY services were volunteered by the kibbutz which provided room and board for the permanent expedition staff of 17 during three seasons of excavation. In addition, mechanical equipment, use of

plastic containers (11) and local workshop services whenever needed for repair and maintenance, were supplied free of charge also by the kibbutz. Affiliated with the expedition team working at the site were an advisory group of experts in various fields of specialization. They were not physically present at the site on a daily basis but followed the findings closely and were later asked to contribute to the overall research, reflected in the present publication.

ONE MAJOR decision had to be taken at the very outset: should the excavation be conducted in a wet or dry environment? Our first idea was to build a cofferdam around the ship, with a breakwater to protect it, and excavate in semi-dry conditions. We had before us the example of the Skudelev Viking Ships excavation near Roskilde, Denmark, which had proven to be a success (12). We favored the idea even more after learning of the difficulties awaiting us in an excavation at a surge zone: artifacts, already vulnerable, could easily be damaged beyond repair by sudden wave actions affecting equipment and divers' movements. Even in normal sea conditions large quantities of sand would drift over the excavated area, again concealing the exposed objects prior to their being recorded or removed. However, after lengthy deliberation and upon considering all possible aspects at that early stage we ultimately chose the 'wet' option. And in retrospect there can be no doubt that we took the right decision for the following reasons:

- A breakwater, constructed on an exposed coast with only some rock outcroppings and a tiny island supporting it, could not have served as adequate protection. Even during a medium force storm it would have endangered the structure and the installations of the cofferdam which it was supposed to serve.
- Legal proceedings and environmental considerations related to the building of such a breakwater could interfere with

the issuing of the necessary permits, causing substantial delay in the overall research program.

- Excavating in semi-dry conditions would ultimately expose the full ship. At such an early stage we had no way of knowing with any certainty how such exposure might affect the stability of the ship's structure. Secondly, even if we were able to stabilize the ship sufficiently to fit it with a mobile crib and lift it out and transport it in its entirety from its original site to a conservation laboratory, the costs incurred in this type of operation would have become prohibitive.
- The next issue to be considered was that of conservation – its place and its method. While we were unsure of the exact size of the ship the early estimates of 12 x 4 x 2 m. meant that we would need to construct a much larger structure than the ship itself in order to have sufficient room around the vessel to be able to study the structure throughout the process. At that early stage of our work, we could not guarantee that such a facility could be found where a structure of this size could be built nor could we estimate or guarantee the huge costs which would ultimately arise.
- We decided early on that the method of conservation would be immersion in polyethyleneglycol (PEG) in two different grades: PEG-400 and PEG-4000. PEG absorption is much less effective on a one-dimensional surface.
- And lastly, the educational and scientific benefits which can be derived from the close study of the various structural elements of the hull when dismantled into small sections, would be lost.

The sand which had been a blessing, covering and preserving the site for millennia, ultimately became a curse. We

recruited all the inventiveness and ingenuity of our expedition's technical staff (13). The first season of work underwater was set for the fall of 1988. At that early stage there was no way to predict a timetable for the completion of the task, but even a most pessimistic view could not have envisioned a ratio of over 2:1 between the number of days the expedition resided at the site and the time its members were engaged in archaeological excavation of the hull and its contents. When sea conditions did not encourage diving activities of any kind the days were spent either dredging the sand which drifted back into the excavation trenches and accumulated over the ship or enjoying the kibbutz hospitality. The more professionally trained crew utilized their time for the treatment and close study of the finds already retrieved.

#### **THE SEARCH FOR THE ORIGIN AND CULTURAL IDENTITY OF THE SHIP**

Upon examining comparative data from Mediterranean shipwrecks for the study of our ship, I became engrossed with the possibility of there having been an exchange of professional know-how and practical experience at sea among shipwrights from different regions. This raised two questions: what might have been the ethnic affiliation of those who built the ship and where was its place of construction?

MARITIME archaeology is providing us with first hand material knowledge of shipbuilding technologies, harbor installations, marine industries and the rich variety of commercial goods which were carried on the open seas between distant ports of call. Another source of information, iconographic depictions of ships – with all their limitations due to the subjective presentation of the artists and the shortcomings of the materials in their use – has also contributed substantially to our knowledge of ships in antiquity.



**This is a view of the coast where the ship was found**



**Removing sand above the ship**



**Excavating the bow**



**The anchor**



**The keel out of the sea**



**Retrieving a frame**



**Ceramic artifacts**



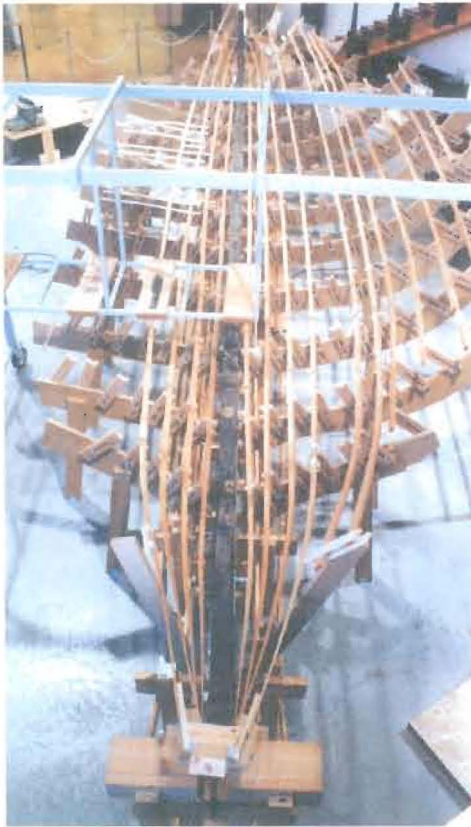
**Installing a plank unto the ship**



**Reassemble process of the ship**



**First stage of ship reassemble**



**The temporary scaffold**



**The hull rebuilt**

The building details that we find in the ships excavated in different parts of the Mediterranean reveal such similar technologies that it leads one to believe that these could only have been developed through direct contact. It is most likely that shipwrights and other craftsmen engaged in ship construction who met during their sailing ventures along the various coasts of the Mediterranean, exchanged knowledge and experience. We know that the application of mortise-and-tenon construction existed through extended time periods with the shell-first technique in various locales advancing to skeleton-first construction. Such techniques were transmitted from place to place. Not only was the application of the mortise-and-tenon technique adapted in various regions but even the computation of

distances between them and the shape of the tenons were so similar that it further points to close interaction. This could hardly be the result of independent invention.

It has been well established that already in the Late Bronze Age, as in later times, there was continuous contact between different maritime entities – especially between the Greeks (Mycenaean, Archaic and Classical) and the Phoenicians (or their predecessors, better known by their earlier name, the Canaanites). As a direct outcome of such contacts an interaction among craftsmen from near and far seems to have developed. This, more than likely, included the shipwrights.

THIS ASSUMPTION is based on the principle theory of diffusion of cultures in the eastern Mediterranean, primarily when

referring to the Greco-Semitic example. With growing evidence from archaeological and literary sources, such theories are now more readily accepted. First, the Greek ethnocentric bias that was so dominant in previous generations of scholarship had to be overcome. Recently, an encompassing – and most convincing – study on the subject argues as to the prominent place to be given to the Phoenicians in the development of seafaring and shipbuilding in antiquity. The arguments as to the prominent place to be given the expansion of Phoenicians and Greeks in the Mediterranean followed two patterns. In their trading ventures and colonization patterns there was natural competition which often led to conflicts of interest. This was particularly evident in the central and western Mediterranean. In their cultural contacts however, there must have been an exchange of technological innovations, the dissemination of the Phoenician alphabet to the Greeks serving as a prime example.

IN THE LATE Bronze Age, Cypriot, Canaanite and Mycenaean ships plied the seas in great numbers. Evidence for such intensive commercial sailing activities is documented in the Ugaritic texts of the time. The archives contained, among others, administrative, legal and economic texts relating directly to the extensive involvement of Ugarit in maritime matters, reaching out far beyond its coastal borders, and pointing to an existing network of thalassocracies (maritime powers) in the Mediterranean already in the middle of the second millennium BCE.

Sea traders whose permanent port of embarkation was in foreign lands sailed regularly to the Ugaritic realm. Commercial transactions were carried out in the harbor area under the auspices of the *wakil-kari*, the harbor master. Such recurring contacts between seafaring merchants from different countries and cultures laid the foundation for an ecumene based on continuous exchange of ideas and technological know-how. Some of

the foreign groups established temporary residence in the harbor zone of Ugarit, using the port facilities and market place, although their rights and privileges were restricted and permanent residence in the kingdom was denied to them. They were welcome in Ugarit during the sailing season when ships from all over the eastern Mediterranean – some from as far away as Crete and from the realm of Mycenae – anchored in the harbor. This opened a brilliant opportunity for an exchange of information regarding ship construction, loading capacities, food preservation, suitable anchorages along common sailing routes and the like.

CONTACTS WITH Kommos in southern Crete was for the Canaanites more than a stop-over along the southern sailing route. This has been lately attested to by the discovery of a Canaanite shrine dated to the 14<sup>th</sup> century BCE at the site, serving evidence of semi-permanent residence.

There is sound archaeological evidence for Greek and Phoenician contacts in the Mediterranean after the so-called 'dark age' when stability returned to the Levant. In the Near East, along the Syro-Palestinian coast, the predominance of Euboean pottery was firmly established. The exchange could have been carried out by an intermediary and Cyprus may have played the role. However, it seems more likely that the harbor of Lefkandi in Euboea served as a direct meeting place between Greeks and Phoenicians as early as the tenth century BCE, having by then a reputation as a shipbuilding center.

Such close contacts between Euboeans and Phoenicians continued in Pithekoussai on the Island of Ischia in the Bay of Naples, where an international community of merchants and craftsmen resided. Al Mina, the Phoenician settlement on the northern Levantine coast, was known for the rich Greek import in the Geometric period, again of Euboean origin. Cyprus played an important part both in the

Greek connections with the east and with Phoenician contacts with the west. Amathus served as a staging point for Greco-Phoenician commercial transactions where sailors and shipwrights could openly exchange detailed information on ship construction and navigation skills.

From the end of the ninth century BCE, there is a strong evidence for the presence of eastern craftsmen in Crete. This phenomenon is in accord with recent studies which claim that the 'orientalizing' of the material culture of Greece began around 900 BCE with immigrant craftsmen and imported objects. Accordingly, it is suggested that eastern settlers are primarily craftsmen and not traders.

When reviewing the organization of the craftsmen and their standing in the social and political order, we find that in Ugarit and in later Phoenician city states, the craftsmen were organized by their specialized occupation and were defined as *bns mlk*, 'royal personnel' or subordinates. In his meticulous study, Heltzer discusses all the aspects of craftsmanship listing more than a dozen fields of specialization. It is interesting to note that craftsmen engaging in woodwork were listed under a separate category referred to as *hrs*, which included the producers of bows, furniture, wagons, chariots and shipwrights, who were known as *hrs anyt*.

In Judea, in the 9<sup>th</sup> century BCE, craftsmen were paid from the public treasury for their work at the Temple in Jerusalem. 'Then they would give the money that was weight out into the hands of the workmen who had to oversight of the House of the Lord and they paid it out to the carpenters and the builders who worked upon the House of the Lord and to the Masons and the stone cutters...'. In the Greek world, we find the term, 'demioergo', to denote artisans, men who served the community by offering their specialized skills.

THE ESTABLISHMENT of colonies in the west by Phoenicians and Greeks became a decisive factor in the mobility of craftsmen. But even much earlier such evidence exists. As an example we have the presence of Canaanite shipwrights at the naval docks in Egypt, indicated by the existence of the Canaanite deities Baal and Astarte at the docks, and some Canaanite names of the shipwrights.

In his study, 'Patterns of Mobility Among Ancient Near Eastern Craftsmen', Carlo Zaccagnini calls our attention to the organization and social status of artisans, following the new socio-economic order in the Greek world and in the pre-Hellenistic Orient, particularly under the Achaemenid rule. Organized groups of artisans belonging to the same profession were formed. They often settled in a particular neighborhood which bore the name of their trade. Being neither slaves nor serfs, they were free to engage in competitive assignments and render their services to whomever required them. They faced no difficulty in procuring raw materials owing to the development of a market economy.

AMONG THE various groups of craftsmen who moved around according to the principle of supply and demand, our attention should be focused on shipwrights operating in this historical milieu. It is suggested that shipwrights *did* move from place to place, *did* exchange knowledge and *did* build traditions which passed on beyond political borders. They chose to construct ships in foreign places where timber was available and abundant, bringing with them their expertise and at the same time absorbing technologies from their local counterparts. In this way, they were able to attain the advanced shipbuilding skills which we here view with such awe.

Thus, rather than speaking of Greek or Phoenician ships and shipping, I suggest we refer to an east Mediterranean ship-building

technology. This may spare us a futile search for a specific 'nationality' of sea-going ships, and instead allow us to view the sea as a bridge and a channel between societies while the ships of the period become instrumental in the process of cultural interaction.

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- 1) In 1989 this government ministry was renamed: The Israel Antiquities Authority.
- 2) At the time Wachsmann was Director and Raveh Co-Director of the Marine Division of the Department of Antiquities and Museums. See Wachsmann 1986.
- 3) Later renamed the Leon Recanati Institute of Maritime Studies.
- 4) Eitam et al. 1978.
- 5) See reports by Mart and Raban, following.
- 6) Golik 1997.
- 7) A good example of this would be the mooring jetty of the Rabin Orot (Hadera) power station, providing coal for electricity.
- 8) See report by Raban.
- 9) Of the Institute of Nautical Archaeology at Texas A&M University.
- 10) Under the directorship of Professor George F. Bass.
- 11) Provided by the Plasson Plastics factory.
- 12) See Muckelroy 1980.
- 13) See following report by Breitstein, for a full explanation of the problems and considerations necessary when working in a surge area.

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