אוניברסיטת חיפה המכון ללימודי ים ע"ש ליאון רקנאטי

R.I.M.S. NEWS

UNIVERSITY OF HAIFA LEON RECANATI INSTITUTE FOR MARITIME STUDIES

REPORT NO. 31, 2005

Dear Friends,

Since the publication of the last RIMS newsletter (No. 30, 2004) three new scientists have joined the staff of the Leon Recanati Institute for Maritime Studies. They are Dr. Uzi Dahari and Dr. Maoz Fine, who are also new faculty members at the Graduate Department for Maritime Civilizations, and Dr. Dror Angel, who is a senior research fellow at RIMS and a teaching associate at the Department.

Dr. Uzi Dahari, Deputy Director of the Israel Antiquities Authority, is an experienced Classical archaeologist. He received his B.A. in Archaeology and Physical Geography, his M.A. in Archaeology and Art History and his Ph.D. in Archaeology, from the Hebrew University, Jerusalem. In 1985 he established the Marine Archaeological Branch of the Israel Antiquities Authority, and was its supervisor for seven years. Among his recent fields of interest are coastal sites, pilgrims' voyages, and underwater surveys and excavations.

Dr. Maoz Fine is a young Marine Ecologist, the recipient of the prestigious Yigal Alon Fellowship for Outstanding Young Scientists, granted by the Planning and Budgeting Committee of the Israeli Council for Higher Learning. Dr. Fine received his B.Sc. in Life Sciences from Tel-Aviv University as well as his M.Sc. and Ph.D. (*Summa Cum Laude*) degrees in Marine Biology. The focus of Dr. Fine's research is on global warming, changes in the marine environment and its effects on marine organisms, especially corals.

Dr. Dror Angel received his B.Sc. in Agriculture from the Hebrew University and his Ph.D. in Biological Oceanography at the City University of New York. His research interests include: environmental impact associated with mariculture, marine microbial ecology, plankton ecology, biogeochemistry, and benthos and water quality issues. Dr. Angel is currently working on several national and international projects (EU Commission, NOAA – USA), some of which are in cooperation with the RIMS marine biological group headed by Prof. Ehud Spanier. He is also a senior research fellow at the Marine Policy Center, Woods Hole Oceanographic Institute, USA.

We wish our new colleagues success in their work at the Institute. We would also like to congratulate our long-standing colleagues, Dr. Dorit Sivan, on receiving tenure as Senior Lecturer, and Dr. Dan Kerem, on his appointment as Senior Teaching Fellow.

In the framework of the 2005 meeting of the Board of Governors of the University of Haifa and in the presence of the President, Rector and Vice-Presidents of the University, Mr. David Recanati unveiled the plaque of the new Elaine Recanati Laboratories for Marine Research (Fig. 1). The construction of this laboratory complex was made possible by a generous contribution from the Recanati family. This is an important milestone in the continuous and kind support shown by the Recanati family; support that has enabled the development of the Leon Recanati Institute for Maritime Studies — the main tool that facilitates marine research at the University of Haifa. We are grateful to the Recanati family, and in particular to Mr. Ariel Recanati, the Chairman of the Board of Directors of RIMS, for this continuous support.

Fig. 1. The Elaine Recanati Laboratories for Marine Research inauguration ceremony, from left to right: Prof. Aaron Ben-Ze'ev, President, Mr. David Recanati, Prof. Ehud Spanier, Director RIMS, Prof. Ada Spitzer, Vice-President (Photo: A. Baltinester)

Any marine research undertaking is divided between the field and the laboratory. Research is not completed when finds are retrieved from the sea. Material must be processed, preserved, analyzed and studied under controlled laboratory conditions. The Elaine Recanati Laboratories for Marine Research will serve our marine scientists from several disciplines, and their graduate students.

This new complex includes a laboratory for the conservation of waterlogged wood retrieved from ancient shipwrecks, excavated by our marine archaeologists; the coastal and marine geomorphological laboratory, where geological samples will be preserved and analyzed to reveal ancient marine and coastal environmental conditions; the laboratory for marine mammals, which will enable the preservation of skeletons and other components of marine mammals found in our coastal waters. The study of these finds will widen knowledge and enable better protection of these magnificent marine creatures. The new laboratories will also enable marine biological studies of some other ecologically important groups of organisms, although more space and equipment is needed for the sophisticated marine ecological studies carried out by the Institute.

Our Institute's Maritime Workshop is our gateway to the sea. The Workshop facilitates our marine research. The excellent diving equipment available to our researchers is maintained and operated by our professional diving officers. Over the years our scientists, together with colleagues from Israel and abroad, and with numerous students and volunteers, under the supervision of our outstanding diving officers, have performed thousands of safe scientific dives.

At present, the RIMS Maritime Workshop is situated off-campus, in the cramped basement of the National Maritime Museum. Our field operational ability is restricted by this unsatisfactory location, while the need for field research constantly grows. We hope to find ways to improve this situation, and hope that the next facility to be inaugurated at RIMS will be a new Maritime Workshop. A state of the art Maritime Workshop, together with the Elaine Recanati Laboratories for Marine Research, and the other Institute units, will enable researchers to continue to advance at the forefront of international marine science.

The Leon Recanati Institute for Maritime Studies was the beneficiary of a generous contribution from the Halpern Foundation, (in Memory of Jeremie 'Yirma' Halpern – one of the pioneers of Hebrew seafaring in the modern era). The support from the Halpern Foundation has enabled us to enrich the RIMS study room by purchasing valuable new maritime literature and several computers for our graduate students. The Yirma Halpern Fellowship for Graduate Students in Maritime Fields was established, and a Zodiac boat with an outboard motor was purchased. A memorial corner honoring the late Captain Halpern was dedicated in the RIMS study room (Fig. 2).

Fig. 2. The memorial corner in the RIMS study room (Photo: G. Karmon)

Fig. 3. Ms. Rama Elad, representative of the Halpern family, inaugurating the new zodiac research boat on Dor beach (Photo: A. Baltinester)

The Zodiac research boat 'RV Halpern', which will serve both our graduate students and faculty members in their research, was launched at a special ceremony at Dor beach (Fig. 3) in September 2005. The ceremony took place during this year's underwater excavation of ancient shipwrecks at Dor, headed by Dr. Y. Kahanov. The Rector, Prof. Yossi Ben-Artzi, the Dean of the Faculty of Humanities, Prof. Menahem Mor, Members of the Board of Directors of the Halpern Foundation, faculty and graduate students, and members of the academic and administrative community of the University, were present at the ceremony.

Providing ongoing support for the next generation of marine scientists is, as always, one of the main objectives of RIMS. In the framework of the annual meeting of the Board of Governors of the University of Haifa in May 2005, as every year, fellowships were granted to outstanding graduate students in marine studies.

The Jacob Recanati Research Fellowships in Maritime Studies are made possible by the generous support of the Recanati family. Jacob Recanati was for many years the Chairman of the Board of Directors of the Leon Recanati Institute for Maritime Studies and has been very active in promoting the institute.

Additional fellowships were awarded to outstanding graduate students in Maritime Studies from the Sir Maurice and Lady Hatter Endowment Funds (Figs. 4 & 5). The continuous and long-lasting support shown by Maurice and Irene Hatter to the marine sciences at the University of Haifa is expressed in many ways. In their generous fellowships for outstanding graduate students; by supporting our important study cruises, such as that to Turkey in the Spring of 2005; by purchasing important scientific marine equipment, and by establishing endowment funds for marine and coastal research.

Last, but not least, two years have passed since the sudden death of our friend and colleague, Prof. Avner Raban, who was one of the central pillars of RIMS and the Graduate Department for Maritime Civilizations. Despite the time that has elapsed, it is still difficult to come to terms with this loss. By continuing the high standard of marine research and educating future generations of marine scientists we fulfill Avner's unwritten legacy.

Ehud Spanier

2005 RECIPIENTS OF THE MAURICE AND IRENE HATTER FELLOWSHIPS IN MARITIME STUDIES

Dor Edelist ◆ Daphna Feingold
Limor Gruber ◆ Simcha Gweta
Nir Hadar ◆ Erez Heilweil
Rafi Kent ◆ Aviad Scheinin
Irit Zohar

Shlomo Aviner ◆ Arad Haggi
Beverly Goodman

Fig. 4. Prof. Ehud Spanier presenting a Maurice Hatter Fellowship to Dr. I. Zohar (Photo: Y. Bachar)

2005 RECIPIENTS OF THE JACOB RECANATI FELLOWSHIPS IN MARITIME STUDIES

Shlomo Aviner ◆ Dafna Goldberg
Erez Heilweil ◆ Rafi Kent
Katy Sharvit ◆ Assaf Tsabar

Fig. 5. Aviad Scheinin addressing the audience on behalf of the recipients of the Hatter and Recanati Fellowships (Photo: Y. Bachar)

JEREMIE (YIRMA) HALPERN
MILESTONES IN A NAUTICAL LIFE

Jeremie (Yirma) Halpern was born in 1901, in Smolensk, Russia, the son of Sara and Michael. The family immigrated to Israel in 1913. Yirma studied at the Herzliya Secondary School in Tel Aviv. Upon completion of his high school education he traveled to Italy where he graduated in 1917 as a Captain from the Italian Naval Academy. In 1919 Yirma graduated from the London School for Captains and Engineers. Later that year he started to work as an apprentice sailor on the Jewish ship 'Hechalutz'.

In 1931, Yirma established the first Naval School in Civitavecchia, Italy, and in 1932 he was appointed to the position of Director of the Naval Department in Beitar. (The 'Beitar' Movement is a youth movement which was founded by Zionist leader Ze'ev Jabotinsky in 1923 in Riga, Latvia). Yirma Halpern was Jabotinsky's right-hand-man.

In 1935 Yirma became the Skipper of the '*Sara A*' (Fig. 1), the first Jewish ship built in the Italian Naval School. Due to his naval education and experience Yirma pioneered in the creation of what later became the New Israeli Jewish Naval Nautical Chapter (Civil and Military). Upon the outbreak of the Second World War, Yirma was appointed by his superiors to negotiate with the Canadian Admiralty for the establishment of a Jewish Naval School. The school was designed to train 1,000 men who were later to make up a special Jewish unit within the British armed forces.

In 1942 Yirma opened a school for frogmen in France, and established a school for skipper cadets in London. Yirma recruited to these naval organizations British admirals and famous figures, such as members of the Rothschild family, who helped gain the British Admiralty's support. 350 naval officers, naval mechanics and fishermen graduated from these schools. Following the purchase of the British frigate 'Cutty Sark' from the British Admiralty, Yirma, together with the Ort Organization, took charge of the vessel.

In 1948 Yirma returned to Israel as a member of the Committee for the Nation's Liberation. He was invited to join the IDF (Israeli Defense Forces) on behalf of the ETZEL (National Military Organization) which was about to end its activities upon the establishment of the State of Israel.

In 1951 Yirma proposed to David Ben Gurion, the first Prime Minister of Israel, to re-organize the Israeli commercial and military Marine Corps (fleet). He also proposed to the government the establishment of a research program which would explore the natural resources of the Red Sea.

Following his proposal Yirma traveled to Eilat together with a team of professional divers and frogmen and conducted the research personally. His initiative led to the establishment of the Eilat Naval Museum, which was later named after him.

In 1954 Yirma was asked by the Israeli government to take up the position of attaché to a French delegation that was to screen and photograph the Red Sea's underwater world. In 1959 Yirma prepared a detailed memorandum in which he suggested that the building of an Eilat Canal should be considered as an alternative to the Suez Canal.

Yirma died in 1962 while trying to turn his great dreams into reality, and writing his book.
"Nevertheless it is my strong belief that Israel will become a great and strong nautical nation. Otherwise it will not stand against the enemies surrounding it and succeed to keep an open gate to the west".

Fig. 1. 'Sara A' — the Jewish training ship

THE ISRAELI MARINE MAMMAL RESEARCH & ASSISTANCE CENTER (IMMRAC), 2005 UPDATE

Holly the sociable solitary dolphin is dead

On Friday, December the 9th, 2004, after 10 years of dolphin-human interactions, 7 of which on a daily basis in front of Nuweiba's fishing village in the Gulf of Aqaba, 'Holly', the solitary social Indian Ocean bottlenose dolphin (*Tursiops aduncus*) was found dead on Rock Sea's beach, 10 km south of Nuweiba Tarabin (Fig. 1). This fact was ascertained some days later from photos which were taken at the scene and brought back to Israel. The photos showed a small penetrating wound on her right flank. It is known that at least on one occasion in the past Holly was stricken by a large stingray, the barb of which traveled the width of her rear. It is possible that this time, the barb entered her abdominal cavity, causing fatal damage. The Bedouins moved her body to the hills and by the time Immrac's volunteers, Sara-Lee Granit & Daphna Feingold, arrived there 10 days later, the body was partly parched and mostly swarming with maggots, making it impossible to confirm the cause of death. Christina Lockyer of Age-Dynamics, Langsby, Denmark, determined her age as 18 at the time of death.

Fig. 1. Holly's dead body, identified by natural markings (Photo: D. Biechonski)

Rough-toothed dolphins invading Haifa Port

IMMRAC volunteers were alerted at dawn on March 22nd to the news of dolphins in Haifa Port. Oz Goffman and Aviad Scheinin, first on the scene, identified a group of 30 rough-toothed dolphins (*Steno bredanensis*) roaming the still waters of the port. The group, in time, split into subgroups of 7-10 individuals, moving in high synchrony and very tight formation (Fig. 2). All size categories were represented, including young calves. The group apparently followed in the wake of schooling gray mullets (*Mugil sp.*) which are known to congregate in and around the port at this time of year. Reliable reports claim that a similar-sized group had been spotted at the same time outside the breakwater. Animals were observed chasing fish out of the water and occasionally with fish in their mouths.

Fig. 2: Close-rank formation typical of rough-toothed dolphin pods (Photo: M. Elasar)

Although on several occasions small groups of up to 3 dolphins (always common bottlenose dolphins *Tursiops truncatus*) strayed into the port, appearing to have lost their bearings, these animals seemed very business-like. Thus, this rare event realized into an information bonanza, with Port Authorities and Naval Security, in a rare show of goodwill, issuing an entry permit to anybody holding a journalist's certificate. The animals spent the entire day intermittently engaged in feeding and in milling behavior. By dusk, the last of the group had left as suddenly as they appeared, thus ending a truly memorable experience. The time of year in which this remarkable event occurred coincides with that of beachings in previous years of mainly young calves of this species, (see: "Rare occurrences of cetacean species along the Israeli Mediterranean coast" R.I.M.S. News No.30, 2004), implying that the local coastal visit of this normally pelagic species may be a seasonal, annual occurrence.

Live stranding of Risso's dolphin calf

On the eve of March the 30th, swimmers at Herzliya beach spotted a stranded live dolphin. Tel Aviv coastguard emergency office was alerted and they relayed the call to IMMRAC whose volunteer rescue team swiftly arrived on the scene. The dolphin was identified as a female Risso's dolphin (*Grampus griseus*) calf, wounded and in a state of exhaustion (Fig. 3). It was stabilized and tranquilized on the beach by Alon Levy, D.V.M., and in cooperation with Yaniv Levy, Head of

the National Turtle Conservation Center in Mikhmoret, transferred to the latter's rehabilitation pool.

Volunteers, organized into shifts, floated the dolphin on a stretcher throughout the night. It received wide spectrum antibiotics and was hydrated by stomach intubations. Yet, although blood tests were not overtly abnormal and vital signs remained stable, the dolphin succumbed on the noon of the next day. The autopsy headed by Shlomi Amiel D.V.M., showed severe external lacerations, some apparently tooth rakes made by other dolphin species. The stomach content showed evidence of solid food intake (squid beaks) but the heart and other organs were exceedingly fat-depleted. This is the second unsuccessful attempt to resuscitate a live stranded member of this species.

Fig. 3. Stranded Risso's calf (Photo: S. L. Granit)

IMMRAC researchers attend an international meeting on cetacean research

This year, for the first time, a delegation of 5 IMMRAC researchers, Daphna Feingold, Meytal Markovich, Aviad Scheinin, Rafi Kent and Dan Kerem, attended the 19th Annual Meeting of the European Cetacean Society (ECS). Prior ECS meetings were attended by two IMMRAC members at the most. The researchers gave an oral presentation at a workshop and presented four posters on varied aspects, having a pronounced impact on participants. The occasion was seized for consulting experts, enquiring about funding opportunities and forming ties with fellow researchers.

Starving fin whale calf dies in Haifa Kishon Port

On March the 31st, a baleen whale was sighted by an IMMRAC volunteer at the entrance to the Kishon/Haifa Port. Murky waters and very limited experience with live whale sightings prevented definite identification and from the estimated 8 m

Fig. 4. Wasted calf alongside freighter (Photo: O. Goffman)

size, it was assumed to be an adult minke whale (*Balaenoptera acutorostrata*). The whale was following a 120 m long Russian freighter and when the latter docked, it was observed swimming back and forth along its port. With the aid of ECS experts, photos and video clips sent to La Rochelle confirmed the reassessment made by Nir Hadar from IMMRAC that the animal was actually a fin whale (*Balaenoptera physalus*) calf. The video footage showed the calf to be emaciated, its backbone very distinct along its entire length (Fig. 4). At the time it was contemplated whether to try and guide it out of the harbor using an 'acoustic wall', as port authorities could not guarantee its safety amongst port traffic. Following consultation with experts at the ECS meeting as well as with staff from 'Sea World' and the US Navy Marine Mammal Facility in San Diego, this idea was dropped as it would impose additional stress upon the already stressed animal.

Meanwhile, the ship's captain claimed that it had followed him all the way from Iskenderun Port in Turkey (this was authenticated by video footage that he had taken of the whale) and that it would probably follow the freighter back out to sea later on that evening. When, next morning the whale was not to be seen, it was assumed that this was indeed what happened. However, eight days later, the calf's body surfaced inside the Kishon Port, at the very place where it was last seen swimming. A very limited necropsy revealed a wasted male calf with an empty stomach but some content in the hind gut. This calf had traveled as far east as possible in the Mediterranean and then headed south along 2/3 of the eastern coast.

This event contrasts sharply to two instances of minke whale calf entanglements (May, 2000 and January 2004), in which the individuals (belonging to the smallest baleen whale species) seemed well nourished. All four previous accounts

of fin whale beachings on the Israeli coast in the last half-century were of decomposed or very thin animals. The easternmost Mediterranean is certainly not a feeding ground and is seemingly also out of the breading grounds range of Mediterranean fin whales. It is quite probable that straying into this oligotrophic cul-de-sac may be a fatal mistake for fin whales of any age.

Multi-day acoustic dedicated cetacean surveys

Last June, a team of IMRRAC volunteers, accompanied by two foreign researchers, Vasilis Podiadis from Athens University in Greece and Fabio Siniscalchi from Italy, performed the first multi-day acoustic sperm whale (*Physeter macrocephalus*) survey in Israeli waters. This whale dives deep and long and is rarely spotted above water, however, its distinct underwater foraging clicks are easily detected from afar.

The survey took place along the Israeli coastline, up to a distance of 65 nautical miles (NM) from shore and lasted for 7 days. The project was supported by Hayim Amit, a yachtsman who made available his Hunter 47 ft sloop 'Princess Lia' and who also covered the travel costs of the foreign experts and their acoustic equipment. During the survey, acoustic monitoring was carried out around the clock, with active listening bouts every 15 minutes. During two nighttime sessions, acoustic identification of sperm whales were made, one of a single individual 35 NM opposite Ashdod and the second a probable identification, 12 NM opposite Hadera, making this the first authenticated documentation of a sperm whale near our coast.

The sperm whale detections together with two visual sightings of Risso's dolphin pods (first live, at-sea, sightings by IMMRAC of this pelagic species), made the survey very rewarding.

Six biannual surveys, planned to take place during the next three years

The above-mentioned survey was a prelude to a series of six biannual surveys, planned to take place during the next three years, starting in September of 2005, aboard Eco-Ocean's 'Med Explorer' (http://www.ecoocean.com). Each 15-day survey will cover 12 offshore-inshore zigzag transect lines along the Israeli shoreline, out to a distance of 30 nautical miles. The surveys have two main objectives:

1. Estimating population sizes of the most common species in the region (i.e. common bottlenose dolphin, striped dolphin, Risso's dolphin and other species for which sufficient data will be collected) by means of line-transect and distance sampling methods.
2. Creating habitat suitability maps for common species in the region by means of ecological modeling and comparing them to similar maps that will be produced for the same species in other regions in the Mediterranean Sea.

Both these objectives serve the same grand scheme which is the construction of a conservation plan for cetaceans in our region, thus contributing to a comprehensive conservation plan that will encompass the entire Mediterranean Sea. This program is being led by ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area).

Surveys of this scale and scope present a breakthrough in Israeli open sea cetacean research, which until now only involved half-day near shore surveys, and allows IMMRAC to join the rest of the world in research abilities and up-to-date methodologies (Fig. 5).

New facility for processing cetacean remains

As part of the new Elaine Recanati Marine Laboratory inaugurated last June, a facility for processing cetacean remains has been constructed. Its main function will be the cleaning and preserving of skeletal remains for the establishment of a comparative collection for research and teaching purposes as well as for mounting whole skeletons for public display. It is hoped that University authorities will favorably consider

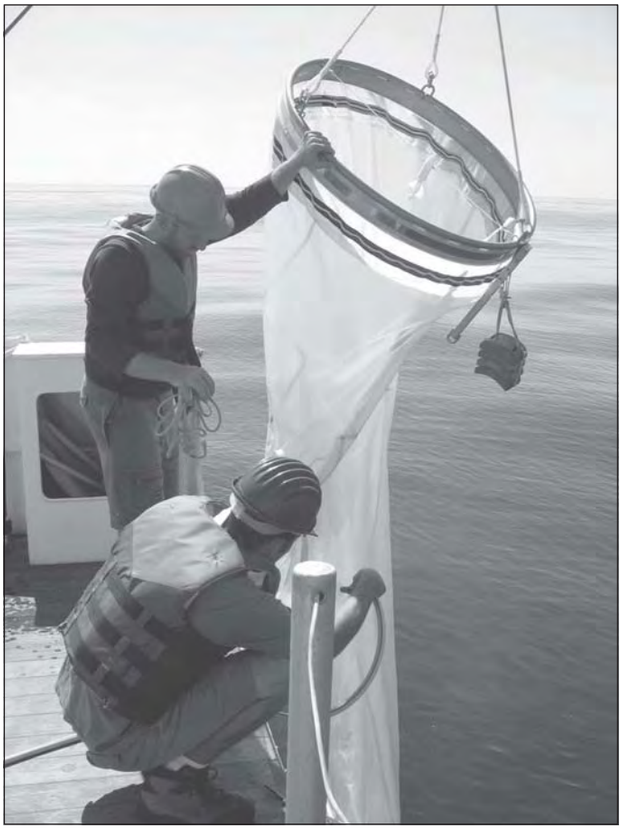


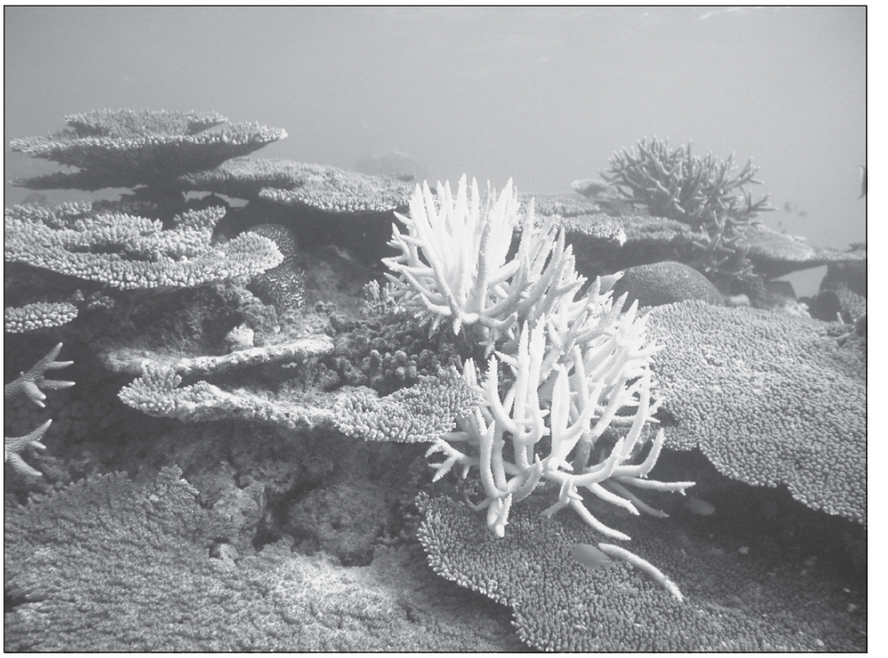
Fig. 5. 'Med-Explorer', retrieving the plankton net (Photo: A. Sheinin)

the allocation of additional space and funding for exposing the regionally unique collection of skeletons gathered over the last decade by IMMRAC to researchers and to the general public.

Other functions of the facility will be the processing of stomach contents for prey item identification and storage of deep frozen and lyophilized tissue samples awaiting genetic, stable isotope and pollutant analyses.

Dan Kerem, Oz Goffman, Aviad Scheinin, Rafi Kent

UNDERSTANDING MICROBIAL ECOLOGY OF CORALS



Reports of disease-like syndromes in reef-building corals have increased since being first reported in the early 70s. This increase has been attributed by many authors to human-driven changes to the environment surrounding corals. Eighteen different syndromes affecting corals have been described worldwide. Disease identification has predominantly occurred on reefs of the Florida Keys and the Caribbean, where disease is now considered the major threat to future sustainability of reefs. Despite several decades of research, a specific pathogen has only been identified for 5 coral diseases. On the Great Barrier Reef (GBR) 'White Syndrome' is the most prevalent, affecting mainly tabulate *Acropora* sp. The syndrome results in a clear differentiation between tissue and white exposed skeleton and is characterised by rapid loss of tissue (Fig. above).

Corals and their dinoflagellate symbionts have often been considered in isolation from the broader spectrum of organisms associated with them, despite the fact that they live in close proximity with a wide array of micro organisms. The primary focus of research is the microbial ecology of corals, particularly as it affects coral nutrition and disease. The answers to these questions are critical to any complete understanding of how coral reefs function. The author's previous work, led to the first case where the organism (a *Vibrio*-like microorganism) was identified as being responsible for this syndrome in the coral *Oculina* in the Mediterranean. Further study revealed a complex interplay between environmental factors such as sea temperature, UV exposure and disease prevalence, explaining many aspects of the distribution of *Oculina*. These conclusions led to further questions as to how the activities of other micro-organisms, such as endolithic microalgae, might influence the physiology of reef frame-builders.

Studies have revealed that endolithic (skeletal-dwelling) microalgae may be critical to the nutrition of corals and that some disease-like syndromes in corals may be due to a coral-endolithic relationship. Most recently, broader questions have arisen concerning the pathology of coral disease, particularly in terms of understanding the critical relationships between corals and the microbial community surrounding them. In at least one case this research has shown (using a range of histopathological and molecular tools such as Fluorescent In Situ Hybridization, FISH) that microbial pathogens may not be involved. In this case, apoptotic cell death is at the heart of the syndrome (white syndrome in tabulate *Acropora* corals).

These types of surprising findings demonstrate that only the surface has been scratched in regard to our understanding of the microbial ecology of corals, and that there is a wealth of new understandings that can be derived from exploring how microbial organisms interact to produce the patterns that we see on coral reefs today.

Maoz Fine

GEOMORPHOLOGICAL RESEARCH

Calculating the terrestrial reservoir age of the coastal Holocene wetlands

The Paleogeography of the Taninim River Mouth and the Kebara Swamps, Carmel Coast, Israel, in the Holocene, is a Ph.D. thesis submitted by Ronit Cohen-Seffer, supervised by Dorit Sivan of the Leon Recanati Institute for Maritime Studies (RIMS) and the Department of Maritime Civilizations, and Moshe Inbar and Noam Greenbaum both of the Department of Geography and Environmental Studies, University of Haifa. Ahuva Almogi-Labin and Amnon Rosenfeld, both of the Geological Survey (GSI), Jerusalem, acted as scientific advisors.

As part of this research, 22 core samples were ^{14}C-dated using the AMS technique: 14 at the NSF Arizona AMS Laboratory, and 8 at the Institute of Particle Physics, Zurich, Switzerland. The analyses were performed on the total organic carbon (TOC) material extracted from the sediments. The Holocene ^{14}C dates were calibrated using the OxCal v.3.8 program (Ramsey, 2001) based on Stuiver et al. (1998a, b), and the Late Quaternary dates were calibrated according to Bard et al. (1993). The radiocarbon dates were not corrected for reservoir age effect before calibration. To date there are no data available on the reservoir age of the Carmel coast wetland. Continental lakes and wetlands have different reservoir ages, and in order to obtain ages that can be correlated to regional and global events, the local reservoir age has to be known.

The research determined the existence of two different marshes along the Carmel coast during the Holocene: the western marsh, which is now covered by sand, and the eastern marsh, the Kebara marshes. The marshes originated at different times, and varied in their lifetime and characteristics. The permanent sources of water feeding the eastern wetlands are numerous fresh to saline springs, known as the Timsah springs, which are the northernmost outlet of the deeper Cenomanian carbonate aquifer (the Yarkon - Taninim aquifer). These springs, at present, form a permanent inland brackish water body of about 0.1 km^2 — a remnant of the past larger Kebara marshes (Almogi-Labin et al., 2002). The water at present is brackish as a result of the mixture between fresh and salty water (Schilman and Almogi-Labin, 2003). The detailed sampling and the taxonomy analysis, carried out by Almogi-Labin et al. (2001), is the key for better understanding the past environmental conditions preserved in the sedimentary archives. These have been studied in two core sequences (Cohen-Seffer et al., in press).

The aim of this continuing research is to calculate the present reservoir age in the Timsah ponds, (now a national park), the only relict of the Holocene Carmel coast wetlands, and to compare it to the past reservoir age. Calculations will be performed by comparing the ages of different materials (seeds, carbonate fossils and organic carbon) all derived from the same unit. This continuing project is carried out in cooperation with Elisabetta Boaretto of the Radiocarbon Dating Laboratory, Environmental and Energy Research Dept., Weizmann Institute of Science, Rehovot, Israel, A. Almogi-Labin of the Geological Survey of Israel, Jerusalem, and Timothy Jull of the NSF Arizona AMS Laboratory, USA. On 26.1.05 samples were taken from the Timsah terrestrial vegetation around the pond (Fig. 1), surface and bottom algae, surface and bottom water; sediments from the bottom of the pond (for TOC analyses), live bivalves and a fish. The samples were taken by A. Yurman of the RIMS Maritime Workshop, who also took the underwater photographs. The radiocarbon analyses will be performed in the Radiocarbon Dating Laboratory at the Weizmann Institute, and in Tucson, Arizona. The data will be compared to different dates from a number of stratigraphical units, to check the possibility that the reservoir age was not constant over time.

Fig. 1. The Timsah pond (Photo: D. Sivan)

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Calculating the marine reservoir age along the shallow shelf of Israel

Following the M.A. thesis carried out by Anat Shmueli, which was supervised by Dorit Sivan and Ehud Spanier both of the Leon Recanati Institute for Maritime Studies (RIMS) and the Department of Maritime Civilizations, University of Haifa, with the help and advice of Christophe Morhange from Aix en Provence (see RIMS newsletter 2002-2003), a continuing project was initiated with the aim of calculating the exact marine reservoir age along the Israeli shallow shelf. The research deals with bio-construction indicators of ancient sea levels that can be dated using radiocarbon. Core drillings were carried out along the edge of the abrasive platform (Fig. 2) consisting mainly of *Dendropoma petraeum* (Vermetidae). Five samples were ^{14}C-dated in the AMS radiocarbon Laboratory at Lyon, France; another 3 at the Institute of Particle Physics, Zurich, Switzerland. Reservoir age

Fig. 2. Drilling cores at the edge of the abrasion platform at Habonim coast (Photo: D. Sivan)

should be taken into consideration for correcting radiocarbon dates of marine fauna. For the Eastern Mediterranean a reservoir age of 353± 47 has been determined (Reimer and McCormac, 2002).

The dates obtained in our research for the *D. petraeum* along the northern coasts of Israel fall within a range of a few centuries. The upper living part of the *D. petraeum* lies at mean sea level, and consequently is exposed during low tide and submerged during high tide. This fact raised the question whether marine fauna, which built its carbonate skeleton in shallow water, has to be corrected by the same reservoir age as deeper water marine fauna.

Henk K. Mienis, the head of the National Mollusks Collection at Tel Aviv University and at The Hebrew University, sampled marine mollusks that were collected live from different places along the Israeli coast before 1950. The mollusks represent shallow marine species and deeper species that live in water depths of 20-30 m. These shells were dated by Elisabetta Boaretto at the radiocarbon dating laboratory (WIS). The research goal is to compare the radiocarbon ages obtained from different sites along a north-south cross-section, and to see if the ages obtained from species that live in water only a few centimeters deep (which are also affected by atmospheric carbon) differ from those obtained from species that live in deeper water and are affected by currents. The research aims to reveal the marine reservoir age of the Israeli coast in general, and if possible, for different water depths.

Reference

* Reimer, P. J, and McCormac F. G., 2002. "Marine radiocarbon reservoir connections for the Mediterranean and Aegean seas". *Radiocarbon* 44: 159-66.

Dorit Sivan

UNDERWATER EXCAVATION AT THE PHOENICIAN HARBOR AT ATHLIT, 2002 SEASON

The underwater excavation at the Phoenician harbor at Athlit was conducted in the summer of 2002. The excavation was carried out as part of an M.A. thesis on the Phoenician heritage and harbors in the Levant during the 9th—7th Centuries BCE. The research deals with harbor location and planning, and the way in which these aspects are demonstrated in the Athlit harbor. The thesis was supervised by the late Avner Raban and Nadav Kashtan.

The purpose of the underwater excavation was to expose the mole walls down to their foundations, as well as to investigate the seabed upon which the mole was constructed. The excavation focused on two areas of the northern mole: Area K1, located in the middle of the mole, on the inner side of the harbor (facing south), and Area L, located at the eastern end of the mole, next to the harbor entrance (Fig. 1).

Area K1 is located at the southern side of the northern mole, about 50 m east of the northern islet. At the beginning of the excavation, the surface area was 2.5 m^2, with a depth of 2.2 m below sea level.

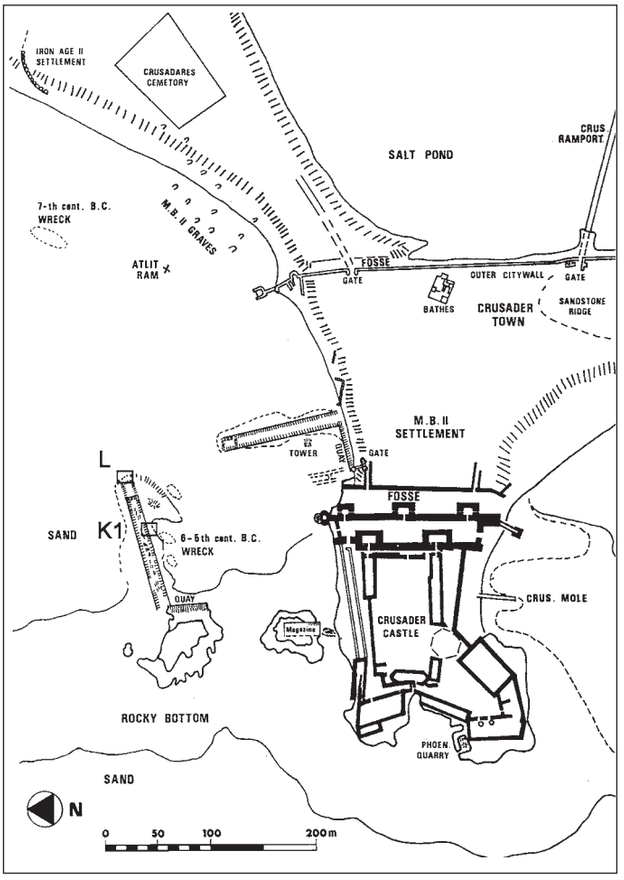


Fig. 1. Athlit Harbor. General plan of excavation areas

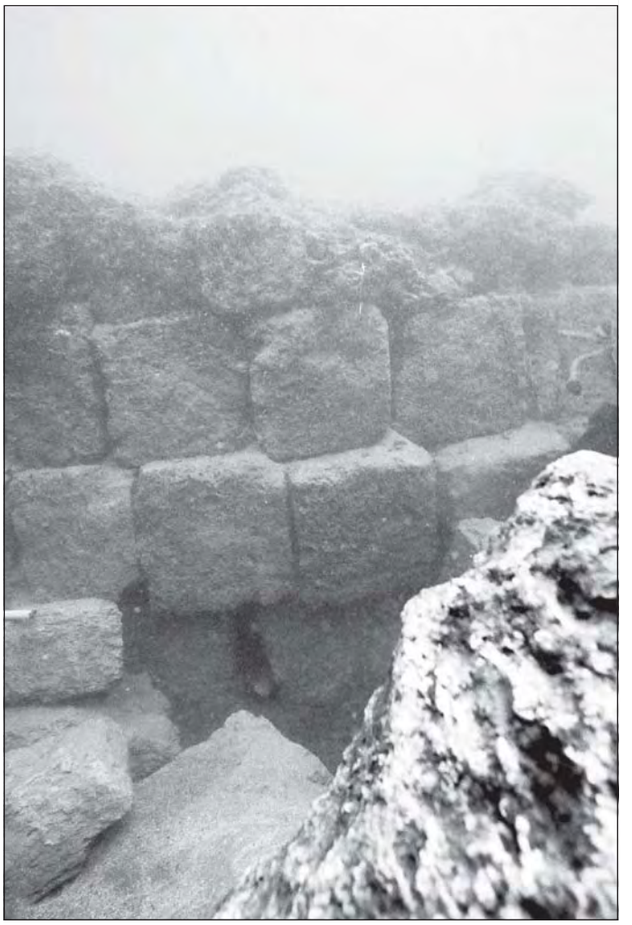


Fig. 2. Wall 100. Exposed ashlar courses, view from the south (Photo: S. Breitstein)

The aim of the excavation at area K1 was to expose the mole's inner wall (southern wall — W.100), to learn about the way it was built, and to understand how the harbor's builders set the sandstone ashlars on the seabed.

Locus 101: This was the main locus of the excavation in Area K1. It started at the surface of the square next to W.100 at a depth of 2.2 m below sea level, and ended at depth of 4.2 m below sea level at the foundation of W.100. Locus 101 contains sand and ashlars which had fallen from the mole wall, and stones which were probably used as a fill between the parallel walls of the mole. Most of the ashlars in W.100 and Locus 101 are of a standard size: 0.5 x 0.5 x 1.0 m. A few are thinner, and were probably used for paving the mole.

Between the ashlars in Locus 101 were sherds, mostly of storage jars. The ceramic finds partially reflect the period that the harbor was in use. Most of the jars are from the Persian period, mostly 'straight shoulder' and 'basket han-

dle' jar types, and also a few sherds of imported East Greek bowls. Between the ashlars were a large number of wooden spacers of *Olea europaea* (European olive) and *Cedrus libani* (cedar of Lebanon). Similar spacers were found between the ashlars of W.100 (see below). They were most probably used to level the courses of stones. The laying of the spacers, and the underwater construction in general, would have been carried out by divers.

^{14}C tests carried out on pieces of wood from the spacers indicate that they date to the 9th or early 8th century BCE. This suggests that the harbor was constructed at least 100 years before the date proposed by Johns, who postulated that the foundation of the settlement dated to 709—663 BCE. It is noteworthy that the wooden spacers from the harbor construction were European olive and cedar of Lebanon, both long-living trees. Thus the age of the wood (as indicated by the ^{14}C dating) could considerably predate the actual use of the samples in the construction of the harbor. Nonetheless, other factors, such as the pottery found in the burial sites, indicate that the harbor dates to the late 9th or early 8th century.

Locus 102: Locus 102 is located under Locus 101 and W.100, at a depth of 4.2—4.5 m below sea level. The locus contains pebbles and broken pieces of sandstone, probably from the nearby quarry. Geological analysis of these pebbles suggests that they were not local, and were probably imported from the region of present-day Northern Syria (Hatay). The stones were probably brought to Athlit as ballast. The role of the thin layer of the pebbles and the broken pieces of sandstone was to prevent waves undermining the mole wall.

Wall 100: The wall was built of eight courses of ashlars, with the narrow side (headers) towards the sea. Much of the wall has collapsed since the harbor went out of use, and today most of the remaining wall stands at a height of 2—4 courses, much of which is covered with sand and debris. The excavation exposed the lowest courses of the wall, which are still in place (Fig. 2). The mud between the ashlars in selected parts of the wall was cleaned out, exposing more wooden spacers. The harbor's constructors used the mud and spacers to level the wall.

Area L is located at the eastern end of the northern mole, next to the harbor entrance. Area L was chosen for the excavation because of the different technique used in building this part of the mole. The depth at the bottom in Area L is 6.2—5.5 m. below sea level.

Locus 301: This locus is located on the seabed, which is covered with a thin layer (20—60 cm) of sand, shells and small fieldstones, resting on the clay soil that is characteristic of the entire region of the *Oren* estuary and the northern bay of Athlit. Large ashlar stones of different sizes are scattered on and in the sand, and run along the entire length of the adjacent wall (W.300). The largest ashlar stones were 0.65 x 0.65 x 1.8 m, while a few stones were smaller, similar to those of the mole wall at Area K1.

Many sherds were found (Fig. 3), particularly jars rang-

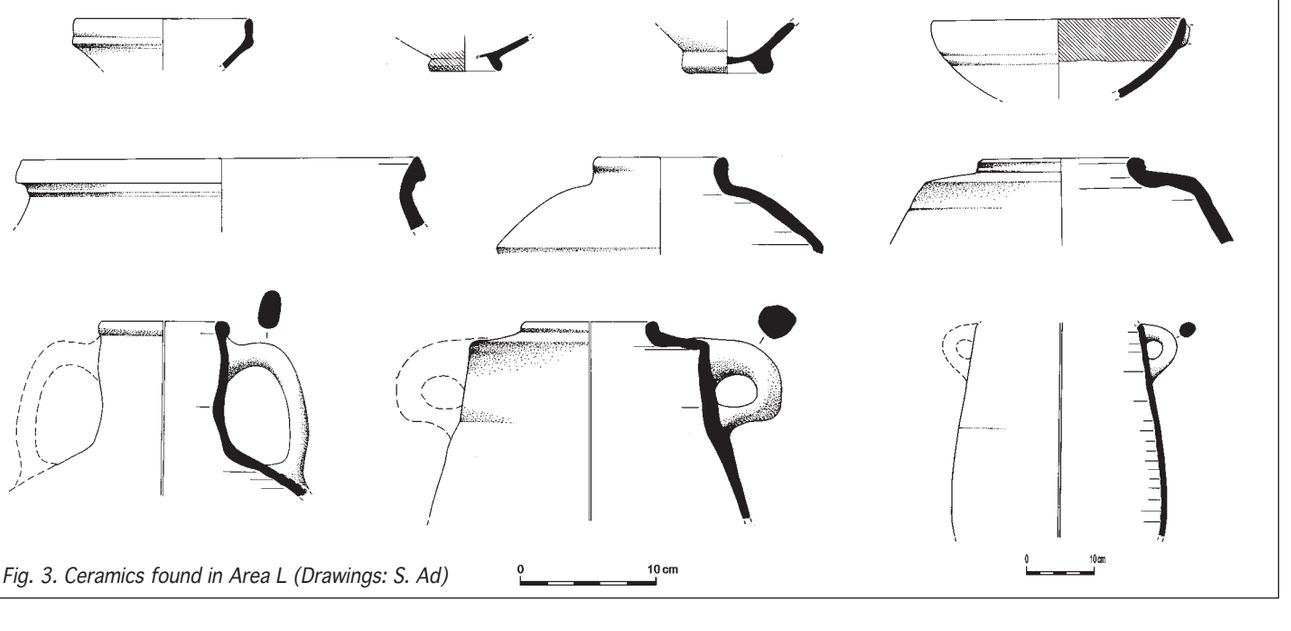


Fig. 3. Ceramics found in Area L (Drawings: S. Ad)

Fig. 4. View of the tip of the northern mole (Photo: S. Breitstein)

ing from the 8th Century BCE to the Persian period ('straight shoulder' and 'basket handle'), including East Greek imports from the end of the Iron Age and the Persian period. Pieces of a cooking pot from the early Iron Age, or perhaps even from the late Bronze Age, were found next to the harbor entrance.

Locus 302: Locus 302 is situated under Locus 301. It contains pieces of sandstone and imported basalt pebbles, which probably have the same origin and function as the pebbles from Locus 102.

Locus 303: The lowest locus in area L, Locus 303 contains the clay soil that is characteristic of the entire region of the Oren estuary and the northern bay of Athlit. At the top of the clay layer were a few flintstone tools that probably belonged to the Neolithic village of Athlit Yam.

Wall 300: This section of the mole was built by a different method than that of W.100 in Area K1. Instead of using ashlar stones, this section was built mainly of fieldstones and semi-hewn stones, which were piled up into a rampart rising to 2.7—3.5 m above the seabed. The bottom layer comprised hewn stones placed on a foundation of pebbles (L. 302). It was overlaid with layers of fieldstones, thus creating a large rampart connected to the east end of the northern mole (Fig. 4). On top of the southern side of the rampart (the inner side of the harbor), which was better protected from the wind and waves, one can see the remains of a building meticulously constructed of ashlars (0.65 x 0.65 x 1.8 m). The size of the ashlar stones used at the top of the rampart was identical to those found in Locus 301. The rampart had probably been used as a platform for various buildings and harbor facilities.

Arad Haggi

DOR 2001/1 — REPORT ON THE 3RD SEASON

The 3rd season of excavation at the site of *Dor 2001/1* was held during three weeks in October 2004. The expedition enjoyed wonderful calm weather and perfect sea conditions throughout the season, with no interruptions to the excavation. This was a joint excavation of RIMS under the direction of Yaacov Kahanov, with Kurt Raveh, and the NAS of Great Britain under Christopher Brandon.

Dor 2001/1 was a medium-sized merchantman, with a length of about 16 m and an estimated beam of 6 m. It was dated by ^{14}C analysis to the late 5th—early 6th centuries CE. Most of the lower part of the hull survived, including the keel, false keel, central longitudinal timber, two central stringers, one endpost (apparently the stem), 19 ceiling planks, more than 20 strakes, 32 frames composed of floor-timbers and futtocks at 32 frame stations, two wales, a stringer/clamp, and a section of the mast step assemblage. The wreck lies northwest (probably the bow) — southeast (stern).

During the first week the cargo of stones resting on the hull, and the sandbags which were laid last year, were exposed. Once the sandbags were removed, an 8 x 2 m metal frame was placed over the hull to protect the timbers while the divers were working. At the beginning of the second week the work concentrated on stratigraphic documentation and photography, and finally the removal of the 80 building stones (with average dimensions of 57 x 28 x 18 cm), which were stacked at the center of the wreck (Fig. 1). After being measured, drawn and photographed, the two layers of stones were removed one by one by flotation. All the stones were placed in a specially dug trench, 3 m west of the hull, at the same depth, about 2.80 m below sea level. Preliminary petro-

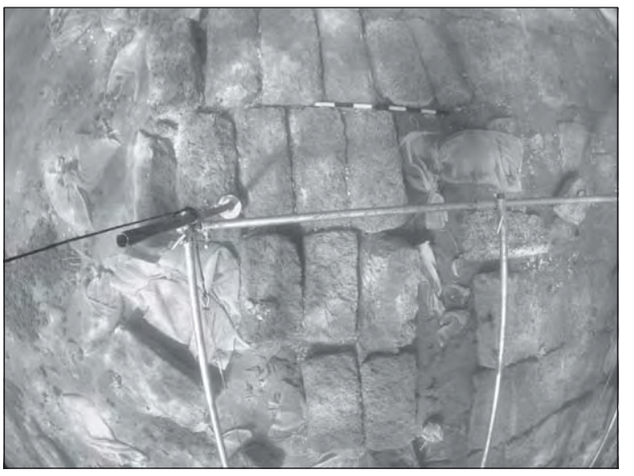


Fig. 1. The cargo stones just before their removal (Photo: S. Breitstein)

graphic analysis shows that they are of *kurkar* (coarse calcareous sandstone) from the vicinity. Once all the stones were removed, the wood that was hidden beneath them was exposed.

A 2.04 m section of the keel was fully exposed at the southeastern end. It was 11 cm sided x 16 cm molded. It was made of soft wood, *Cupressus sempervirens* (all the wood analysis was made by Nili Liphschitz, Institute of Archaeology, Tel Aviv University).

The false keel was made of hard wood, *Quercus coccifera*. It was 11 cm sided (like the keel) x 5 cm molded. It was connected to the keel by nails, probably of metal, which were verified only by touch, since it was decided not to dismantle the joint just yet.

An endpost, apparently the stem, was found connected to the northwestern end of the keel, though it was poorly preserved. It was 10 cm sided x 20 cm molded at its top end. There was a notch 9 cm beneath its upper surface, evidently a rabbet, into which both garboards were fitted. There was no evidence of joints or nails in the rabbet. It seems that the garboards were laid against the endpost and keel, and the gap was filled with caulking material, which has not yet been identified.

The central longitudinal timber, 15 cm sided x 18 cm molded, found at the northwestern end of the hull, was initially identified as a keelson. After the stones were removed, it was discovered that it was only about 2 m long. It had not been broken; this was its original length. It was made of hard wood, *Quercus coccifera*. It seems that it was simply laid upon the frames and just touched the endpost. At each side were timbers, which were denoted as sister keelsons east and west, made of *Cupressus sempervirens*. They are now believed to be two central stringers.

Altogether, 32 floor-timbers were disclosed on the eastern side, with the same number of futtocks. They averaged 10 cm sided x 8 cm molded, with room and space of 24 cm. Some floor-timbers were larger: 13 cm sided x 10 cm molded, and some smaller: 8 cm sided x 7 cm molded. They alternated: large frame — small frame — large frame, etc, at least at the center section of the hull. They were connected to the keel by rectangular metal nails, 6 x 6 mm.

Most of the 32 floor timber-futtock joints are still hidden under ceiling planking; therefore the framing pattern, turn of the bilge, and means of joining are still unknown. All the floor timbers had at least two limber holes (a few had three), one on each side of the keel, above the garboards.

For the first time more than 20 planks of *Cupressus sempervirens* were exposed, 9 surviving on the western (port?) side, and probably 15 on the eastern (starboard?) side. They were 2.5—3 cm thick, and 10—17 cm wide. On the eastern side two of the planks were wales made of half-logs. All the planks were attached to the frames with rectangular metal nails, with average dimensions of 5 x 5 mm. Some planks were butt-joined at frame stations, and caulking material was found in the seams. No evidence of mortise-and-tenon joints or planking edge joints was found.

Fig. 2. The eastern (starboard?) side of the hull (Photo: S. Breitstein)

19 ceiling planks were labeled, measured and documented: C1—C11 on the eastern side of the keel, and CA—CH on its western side. They were all made of *Pinus brutia.* They were attached to the floor timbers, using rectangular metal nails with average dimensions of 5—7 mm. The nails were placed on either side of the plank, at intervals matching the frame room and space of 24 cm. Some planks had no fastenings, and were just placed on the frames. One of them, probably the sump cover, was taken out for laboratory analysis.

C1—C9, which were laid horizontally above the floor-timbers on the eastern side of the keel, had different dimensions on either side of the mast step sister: to the north they were 2—2.5 cm thick and 14—25 cm wide, and to the south some were drop-strakes, 6—9 cm wide (Fig. 2).

C9, with the chine strake, created the turn of the bilge. It was 6 cm thick, more than twice that of the other ceiling planks. The chine strake had a radius of 6 cm. C10—C11 were laid vertically against the eastern side of the hull.

CA—CH, which were laid horizontally above the floor-timbers on the western side of the keel were also 2—2.5 cm thick, with an average width of 14 cm.

A stringer/clamp was connected above C11 to the frames on the eastern side of the hull by several metal nails. It was a massive timber, made of *Pinus brutia*, measuring 6 cm thick and 11 cm wide. It survived to a length of 3.90 m,

though it was probably longer, perhaps the entire length of the eastern side of the hull.

The mast step position has yet to be determined. It was apparently located in a narrow longitudinal space left between the central stringers. A timber, 122 cm long, 35 cm wide and 6 cm thick, with a rectangular groove measuring 8 cm x 16 cm, lying at 90^0 to the hull's longitudinal axis, was probably one of the mast step sisters (Fig. 3).

The hull remains; with frame nailed to the keel, the fact that all the planks and ceiling planking were attached to the frames only by metal nails, the presence of the caulking material in the seams, and planking butt joints at frame stations, all lead to the conclusion that *Dor 2001/1* was built in a 'frame-skeleton based' construction technique.

Fig. 3. The center of the hull: keel, planks, floor-timbers, ceiling planks and mast step sister (Photo: S. Breitstein)

Thanks

We would like to take this opportunity to thank Lord Jacobs and the Hecht Foundation for their financial support for this season's excavation. This research was supported (in part) by the Israel Science Foundation.

Last, but not least — thanks to all crew members and the many volunteers who participated in the excavation and made it all possible.

Hadas Mor

Students in action at Dor (Photo: D. Gary)

TANTURA F WRECK
2004 EXCAVATION SEASON

Tantura F was discovered in 1996 during a survey by a combined expedition of the Institute of Nautical Archaeology at Texas A & M University (INA) and the Recanati Institute for Maritime Studies (RIMS), headed by S. Wachsmann. In the 2004 excavation season the wreck was excavated by a combined expedition of the Nautical Archaeology Society of Great Britain (NAS) headed by Christopher Brandon, and the RIMS headed by Yaacov Kahanov, together with Kurt Raveh.

Based on ^{14}C and ceramic analysis, the wreck was dated to the 8th century CE, which is the local early Arab period.

The wreck is orientated roughly north-west/south-east, about 70 m offshore, a few meters north-west of the lagoon's navigable channel. It is in 0.85 m of water, buried under an additional 1.5 m of sand. The archaeological remains spread over an area 12 by 3.5 m, and comprised the keel, frames, planks, central longitudinal timbers, stringers, and the mast step assemblage. The hull survived up to the turn of the bilge, and almost to the bow and stern.

The keel of the ship was made of *Pinus brutia* and *Pinus nigra*, identified by N. Liphschitz. Where measurable, its average dimensions were 9.5 cm sided and 16 cm molded. No rabbet or chamfered corners for fitting the garboards were evident, but rabbeting was identified at the ends.

31 frames were recovered, including floor timbers, pairs of half frames, and futtocks. They were made of *Tamarix smyrnensis* and *Pinus brutia*. Generally, the framing pattern was of alternating floor timbers and half frames. Under the mast step the frames comprised a series of floor timbers only. Frames were on the average 8 cm sided and 11 cm molded, with room and space of 28 cm. They were iron-nailed to the keel. 15 futtock timbers were recovered, iron-nailed to the floor timbers. They were fitted randomly forward or aft of their associated floor timbers. Two central longitudinal timbers were found at the bow and the stern of the ship. They were notched on their undersides for fitting onto the frames. These timbers were about 2 m long, 14.2 cm wide and 14.5 cm thick.

The shell planks were made of *Pinus brutia*, and were connected to the frames from the outside by small iron nails of 0.5 mm average square cross-section. Planks were on the average 2.5 cm thick, and in widths varying from 8 to 20 cm. No planking edge joints were found anywhere, although not all the edges of the planks were exposed. Caulking was found in many places between seams.

Eight longitudinal stringers were found. They were made from half-logs; six were placed with their flat side on the frames, and two with their flat side upward. The stringers were iron-nailed to the frames from above. No ceiling planking was found.

Fig. 1. Tantura F. The mast step assemblage (Photo: S. Breitstein)

The mast step assemblage comprised the mast step itself and two lateral sisters (Fig. 1). All components were

Fig. 2. Tantura F. Pottery remains in situ (Photo: I. Grinberg)

made of *Pinus brutia*. The mast step was not nailed to the stringers beneath it, or to the hull. Measurable dimensions were 145 cm long, 26 cm wide and 20 cm thick. There were two mortises on its upper surface. The smaller forward one measured 10 x 4.5 cm and 5.5 cm deep, and probably secured a stanchion supporting a mast partner. The after mortise, measuring 23 x 5 cm and sloped 2.2 cm, probably served to secure the mast heel, defining the direction of the bow and stern.

The concept and construction of the hull, which was based on keel, frames nailed to the keel and longitudinal reinforcing members, to which planks were nailed and later caulked, was clearly of skeleton orientation.

The pottery found includes jars, some containing fish remains, a juglet and amphoras of the early Arab period (Fig. 2). The organic materials found included a rope, a wooden roundel (Fig. 3), a reed mat , a wooden spoon, a large needle, and a large amount of fish bones, carobs and olive pits.

Since very few wrecks from this period had been exposed in the Mediterranean, future excavations are expected to add to the knowledge of shipbuilding, seamanship and the history of Dor in the Arab period (Fig. 4).

Ofra Barkai

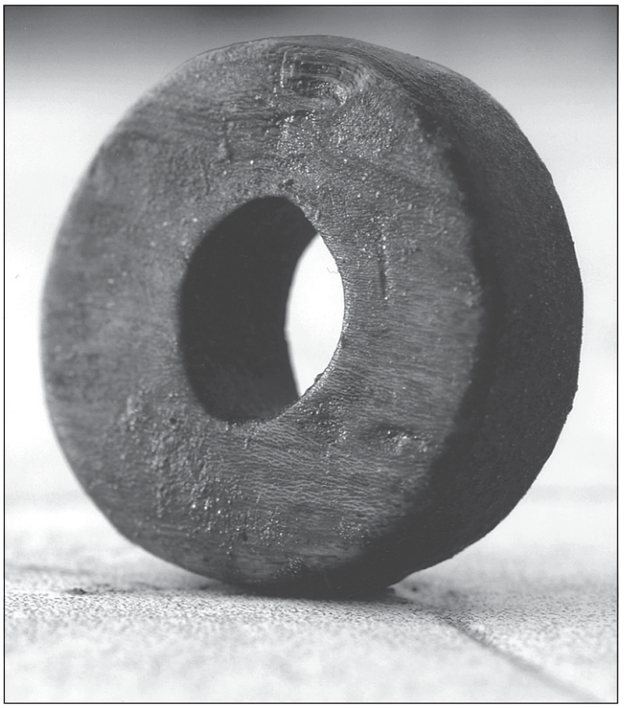


Fig. 3. A wooden roundel found at Dor F (Photo: I. Grinberg)

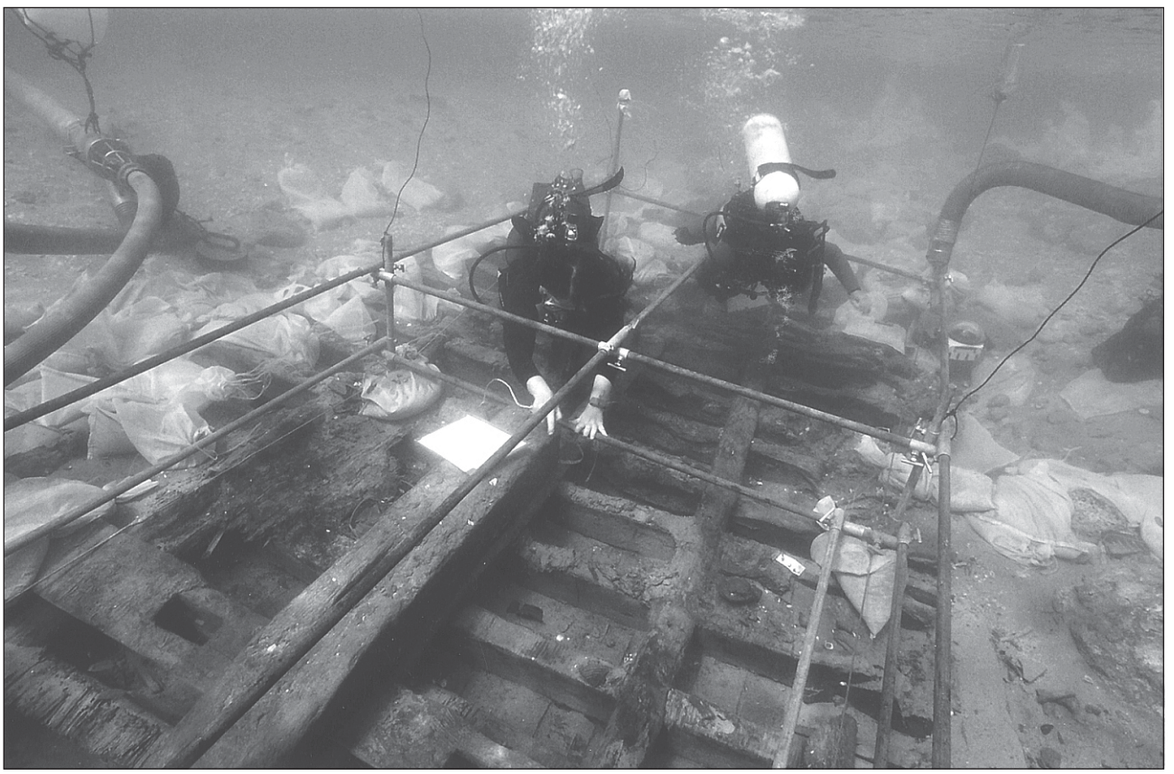


Fig. 4. View of the ship (Photo: I. Grinberg)

SUMMARIES OF THESES SUBMITTED TO THE DEPT. OF MARITIME CIVILIZATIONS, 2004-5

THE *DW2* WRECK AND ITS FINDS AS HISTORICAL EVIDENCE FOR COASTAL TRADE IN SOUTH SYRIA AND ISRAEL IN THE 17TH AND 18TH CENTURIES

The Dor Wreck 2 (*DW2*), found in the southern lagoon of Dor beach, was excavated during three seasons by the Marine Archaeology Unit of the Israel Antiquities Authority, the Institute for Maritime Studies at the University of Haifa, the Aqua Dora Diving Club and the Nautical Archaeology Society of the UK. The wreck, a small sailing vessel, dated to the Ottoman period, has partially survived in reasonably good condition. Extant timbers comprise the keel, an endpost, frames, the keelson, the stemson, a crotch timber, the mast step, stringers, a bulkhead, strakes and inner strakes, ceiling planks and part of the deck. The cargo did not survive, although a few organic and ceramic finds were found.

The research centers on two main aspects. The first is a study of the historical sources and data on coastal commerce between the ports of south Syria in the 17th and 18th centuries. The second aspect deals with the structure of small vessels in the eastern Mediterranean during this period, through a comparative study of the wreck with historical and archaeological data. Analysis of the data also answered questions regarding the origin of the wreck, the location of its construction, its route, its period of operation, and the importance of its final anchorage.

Communities, originating in Greece, emigrated during the 17th and 18th centuries to the coastal cities of southern Syria and Israel. The Greek communities in the Levant had a similar familial — cultural framework that maintained both character and regional inter-community ties. Assimilation in the local economies allowed these communities to develop parallel commercial systems based on these ethnic ties. The staple of this commercial web was agricultural products, especially grains, delivered in small vessels. The large range of vessels used included many vessel types, such as the Gatzao in the Ionic islands, the Tserniki, Trchandiri and Perma from the Aegean Sea, the Çerktrime from the Black Sea, etc. Geo-political changes that reduced the volume of European commerce brought about the expansion of Greek commerce from the Black, Aegean and Adriatic Seas to Egypt. The increase in the volume of Greek trade saw a concomitant increase, during the second half of the 18th century, in the numbers of vessels produced by Greek shipyards. Despite this, southern Syria and Israel's commercial volume remained low, as local problems diverted trade to Egypt and Asia Minor.

Evidence from pilgrims and European visitors helped complete the reconstruction of coastal commerce in southern Syria and Israel. Their descriptions include commercial activities, some undocumented by the authorities, conducted with small vessels, operated by both Greeks and locals, sailing from port to port. The cargo was mainly agricultural. The conditions of the ports of southern Syria and Israel, characterized by access problems, shallow depths and shoals, allowed only small shallow-draught vessels to operate safely and easily.

The *DW2* wreck was built skeleton-first using the techniques of the Mediterranean shipbuilding tradition. The skeleton, including the keel, stem, frames and keelson, was apparently constructed in the master frame and ribbands system. Characteristics of the Mediterranean tradition are:

— Construction of the skeleton first.

— The mast step construction from two horizontal and two vertical supports. The vertical supports also served as the base for the deck-planking, as do the longitudinal fastenings.

— Dovetail or hook scarfs joining the futtocks to the floor timbers.

— The scarfs on the midship frame change direction, affecting the direction of the futtocks.

— The midship frame is flat, and wider than the other floor timbers.

— The distance between each pair of frames is equal to the width of two floor timbers.

— The use of naturally curved wood (Fig.1).

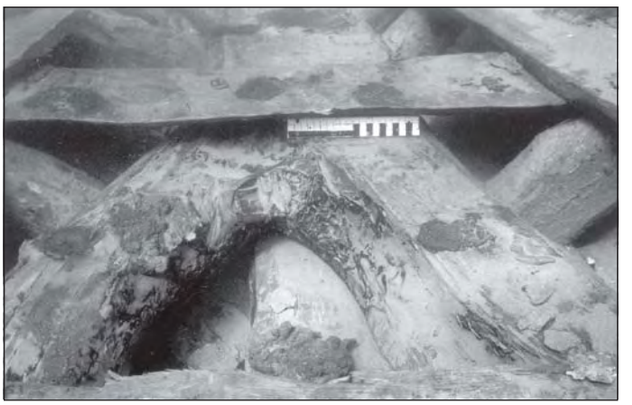


Fig. 1. DW2, Y - Crotch timber in the bow (Photo: N. Sheizaf)

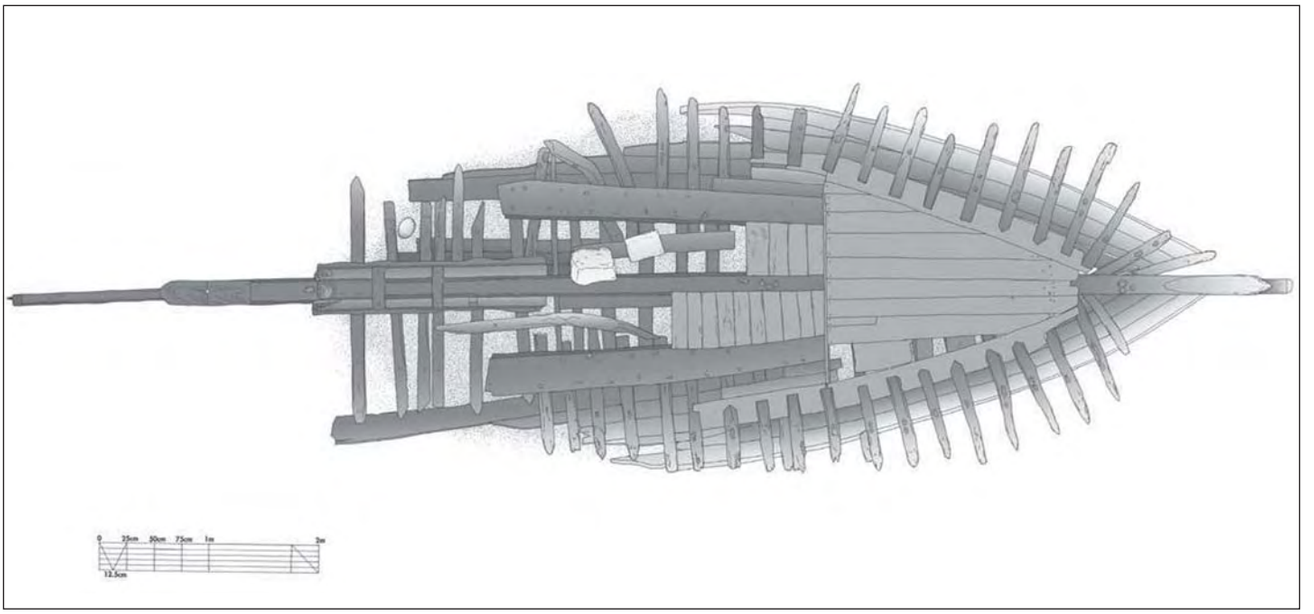


Fig. 2. General view of the DW2 wreck (Drawing: C. & K. Brandon)

The ship was built in western Turkey from poor quality, stressed adult pines, containing a large number of knots. The poor wood quality required highly skilled carpentry, as evidenced by the use of all tree sections and the small range of tools.

The assumed original length of the wreck was 15.5 m. The surviving end was apparently the bow. According to the traditional ratio between the length, width and height in merchant ships, the assumed maximum beam was 4.4 m and its assumed height 2.2 m, and the maximal capacity was about thirty tons (Fig. 2).

The ceramic finds originated in Syria. This identified the *DW2*'s shipping route along the coast before her sinking at Dor. At this stage of the research, it is not clear whether Dor was the final destination.

The *DW2*'s construction and operation is dated between the second half of the 18th and the first half of the 19th centuries (Fig. 3).

A technical comparison of the *DW2* to other excavated Mediterranean wrecks (the *Camargue 8* wreck, the *Kitten* and the *Dor 2002/2* wreck) shows similar Mediterranean shipbuilding characteristics. In addition, the outer hull of the *DW2* was compared to that of Greek vessels from the 19th and 20th centuries. The greatest similarities are with the *Black Sea* wreck, the *Kitten*. In comparison to the *DW2*, the *Kitten* is larger, and more massive and complex, but has similar Mediterranean characteristics, as well as several other similar construction characteristics. These include the two metal nails joining the strakes to the frames, a large niche at the base of the mast step for the mast heel, thick strakes, and similar scarfs. It is possible that these elements hint at a similar building tradition. Alternatively, these may be additional characteristics of the Mediterranean tradition. At this stage, it can only be determined that the *DW2* was built according to the Mediterranean tradition, but neither its regional tradition, nor the ethnic identity of its shipwrights, are identifiable.

Idit Yovel

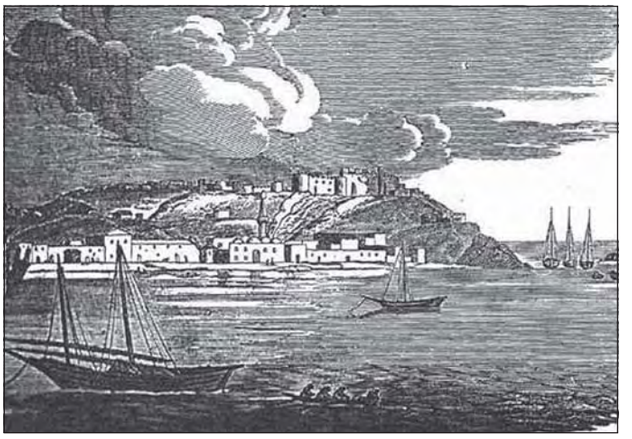


Fig. 3. The port of Jaffa (Buckingham, 1822). The two anchored vessels resemble the DW2 wreck

ARCHAEOLOGICAL AND HISTORICAL EVIDENCE IN TANTURA LAGOON OF THE MARINE ASPECT OF THE RETREAT OF NAPOLEON AND HIS ARMY FROM ACRE

In May 2002 a wreck was exposed on the shoreline of Tantura lagoon by Kurt Raveh, and designated *Dor 2002/2*. This discovery led to the recent research on the possible association of the wreck with Napoleon's expedition to the Holy Land in 1799 (Fig. 1).

The research focuses on two disciplines: the first is the historical evidence which describes Napoleon's expedition, and especially that related to the events in Tantura lagoon. The second is the archaeological evidence, which includes the wreck itself and its finds, together with other archaeological finds in Tantura, which might show a connection to Napoleon's army.

The French army, led by Napoleon, abandoned the siege of Acre in 1799, and retreated south along the coast towards Jaffa. They reached Tantura on 21st May, carrying with them their artillery, small-arms, ammunition and the sick and wounded. At Tantura, many more sick and wounded soldiers were found awaiting evacuation, for whom it was necessary to use any viable means of transportation. Evidently there was not enough shipping space available, so weapons, equipment and ammunition were either destroyed, buried on shore, or sunk at sea, in order to make room on the carriages for the wounded. It is likely that two 24-pounder cannons were too heavy to be carried into the sea, and were therefore buried on shore. However, the accounts of what happened while Napoleon's army was in the Tantura area during the night of 21st—22nd May differ, mainly in the disposal or destruction of weapons, and the method used to transport the sick and wounded soldiers to Jaffa.

In order to learn more about the ship and the circumstances of its wrecking, two underwater excavations were conducted during 2002 and 2003. The wreck was discovered near the shoreline, in very shallow water (Fig. 2). This fact led to the preliminary assumption, by Kurt Raveh, that this was a raft, used by Napoleon's soldiers. According to this assumption, when the soldiers were ordered to dump weapons and ammunition in the sea, they needed a vessel. In order to dispose of the heavy artillery, which was impossible to load onto small vessels for lack of proper equipment, the soldiers improvised a raft, which was dragged by horses towards the sea, but which broke up on the shoreline.

From the 1960's onwards an interesting variety of weapons have been found on the sea bottom in and around Tantura lagoon, some of which have been retrieved. These weapons reinforce the historical evidence relating to the events at Tantura. There is no doubt that the muskets found were of the type used by the French army, and it is very probable that the cannon balls, shells and bullets were also connected to the events of that night. As for the Spanish mortar and the Turkish cannon which were found in the lagoon, it has not been possible to prove a direct connection between them and the French army, although the possibility cannot be ruled out.

Based on the historical documents, there is no doubt that there were craft in Tantura lagoon, used by the French army

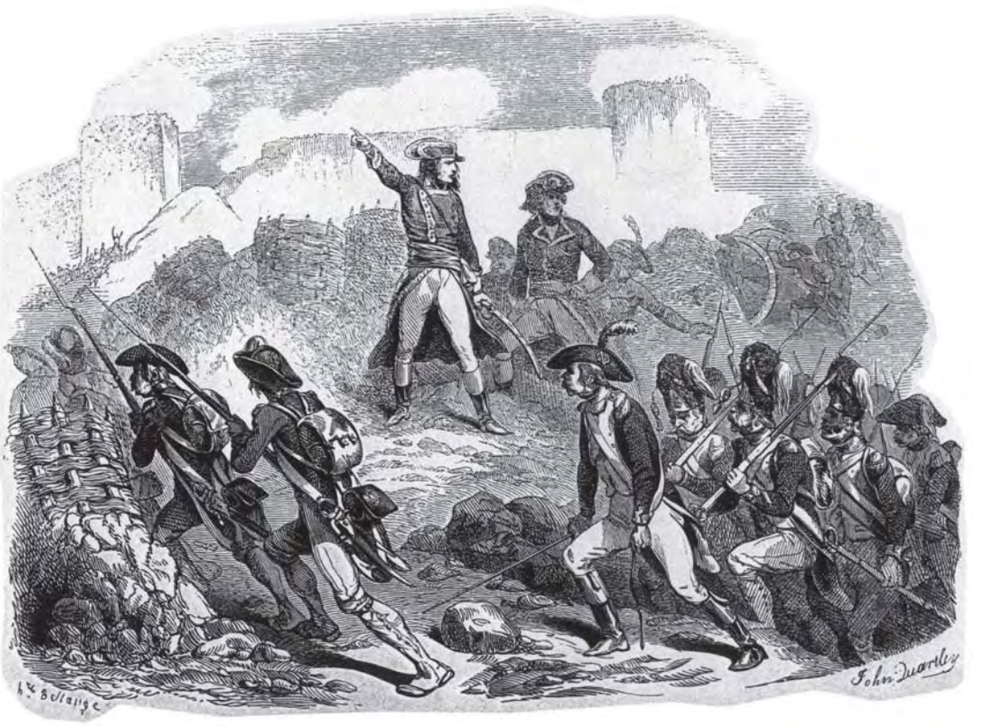


Fig. 1. Napoleon laying siege to Acre (Barthelemy et Mery, 1850, 134-5)

Fig. 2. The shallow excavation area, view from West to East (Photo: E. Linder)

in order to sink the weapons and ammunition at sea. They were small in size and few in number. Another important use of these vessels was the transportation of the wounded from Tantura at least as far as Jaffa.

Initially, the discovery of *Dor 2002/2* raised the possibility that the wreck was, in fact, a raft. However, even during the first excavation season, it turned out that it was probably the starboard side of a hull. The possibility that the hull itself was used as a raft was dropped, since no evidence of secondary usage was found.

The fact that the wreck was only a small part of a vessel made it difficult to categorize it. However, the conclusion is that the original ship was about 15 m long, with 4.5 m beam, 1.35 m draft, and a displacement of about 35 tons (Fig. 3). The ship had probably one mast.

Regarding the construction tradition, after considering different types of vessels in the Mediterranean, no definitive solution has been reached. The origin of the wood used in building the ship may be either Greece or Anatolian Turkey. In addition, one must consider the similarity between some elements of the wreck and Greek vessels, especially in light of the fact that Greek shipwrights traveled throughout the Mediterranean, working and carrying with them ideas and different ship construction methods. Therefore, it is suggested that the ship was constructed in the general region of the origin of the trees.

One of the problems facing the research was the determination of the wreck's age. The fact that only a remnant of a vessel was found, lacking any artifacts or other evidence that could shed light on its age, made it difficult to answer this question on the grounds of construction method alone. Samples of wood were sent to several laboratories for analysis. A variety of analytical methods were used, but could not determine an exact date for the wreck. According to the

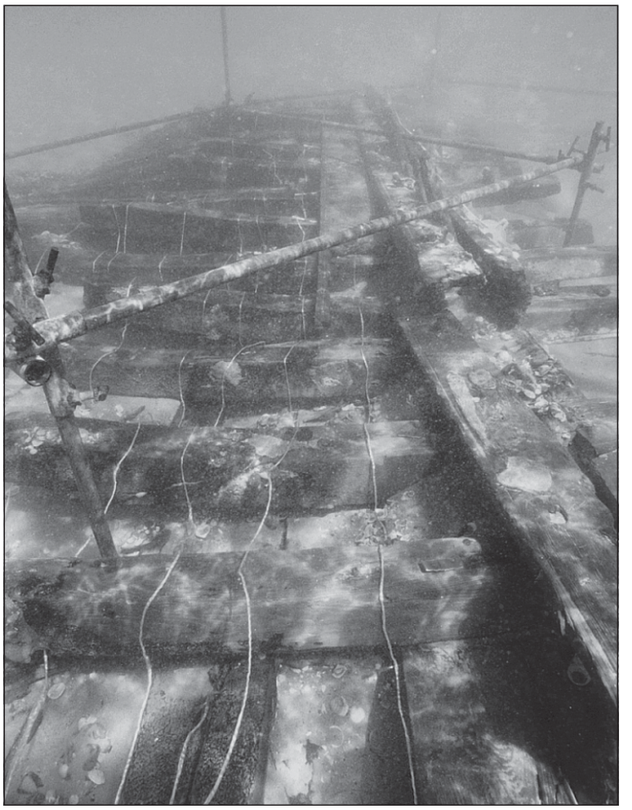


Fig. 3. Dor 2002/2 wreck. View of the ship (Photo: N. Sheizaf)

conclusions of the different laboratories, and following mathematical calculations, the wreck's estimated date is 1800.

This research cannot offer a definite solution as to the relation between *Dor 2002/2* and the French expedition to the Holy Land in 1799; we can only speculate. It is possible that the wreck had nothing to do with the French army. Nevertheless, due to its age and context, it is possible that there is a connection between the wreck and the events of that period.

The great effort which was put in shaping the wreck's components indicates that it was built by some authority. It might have been a government or a military vessel used by the Turkish navy during the French expedition to the area. It might have been one of the ships used by the British navy harassing the coastal positions of the French army, or it might have reached Acre as one of the fleet of Turkish vessels that sailed from Rhodes and was taken by the French fleet. Maybe it was anchored in Jaffa harbor when it was taken by the French forces, or maybe it was one of the two captured Turkish ships which anchored in Tantura, and were supposed to evacuate sick and wounded French soldiers.

Deborah Cvikel

THE ORIGINAL MA'AGAN MIKHAEL SHIP

The Ma'agan Mikhael ship was a small merchantman which sailed the Mediterranean towards the end of the 5th century BCE (Fig. 1).

Maritime transport of goods during the 8th to 4th Centuries BCE — the Archaic and Classical Greek periods — was in the hands mainly of Phoenicians and Greeks, with the Etruscans participating on a more limited scale.

Although literary descriptions of merchantmen or their construction are few, there is considerable archaeological evidence. Underwater archaeology has helped to document and reconstruct dozens of ancient ships dating to as early as the 14th Century BCE. These discoveries have led to significant insights into common construction methods used in the Mediterranean for almost 2000 years.

The wreck was discovered on the Mediterranean coast off the shore of Kibbutz Ma'agan Mikhael. Following its excavation, it was conserved and reassembled, and is now displayed in the Elisha Linder Museum, an extension of the Hecht Museum at the University of Haifa. It has provided much information on ship construction techniques.

The ship was built mostly of pine, and was estimated, according to preliminary studies, to be about 13.5 m long, with a displacement of approximately 23 tons. She was driven by a single square sail. The origin of the ship and the route of her last voyage have yet to be definitively established.

Many of the Ma'agan Mikhael's components, construction methods and assembly details, and the materials that were used, have been investigated. Among the components which have survived are a large portion of the hull, including the keel, false keel, and the lower parts of the stem and sternpost, with two scarves and two knees. Sections of all 14 floor timbers have survived, seven of them, on the starboard side amidships, with futtocks. Much of the planking of the starboard side has survived, including two wales; the 10th and 12th strakes. In addition, some of the internal components, such as the stringer, the mast step, and two mast partner beams were found. The ship's hull was wine-glass shaped, built by the 'shell-first' method, and the planks were connected by closely-spaced pegged mortise-and-tenon joints. Some components of the ship's hull: the knees, the ends of the keel and the lower planks, and the lower parts of the stem and sternpost, were sewn.

The purpose of this study was to determine the Ma'agan Mikhael's original hull lines and stability. The results of this study will form the basis for constructing a replica of the ship.

The drawings of the archaeological finds were used to produce the hull lines, using AutoCAD 2000. The first step was to draw the keel with the false keel and the knees, placing the 14 frames on top. Then, the frames were extended to a height equalling frame no. 9, since it is the central and best preserved one.

Four iconographic depictions in different media dating from the 6th to the 5th century BCE, chosen because of their similarity to the Ma'agan Mikhael wreck, were analysed.

Having reached the height of the archaeological find, the hull lines were completed by extrapolating and incorporating information determined from the iconographic evidence.

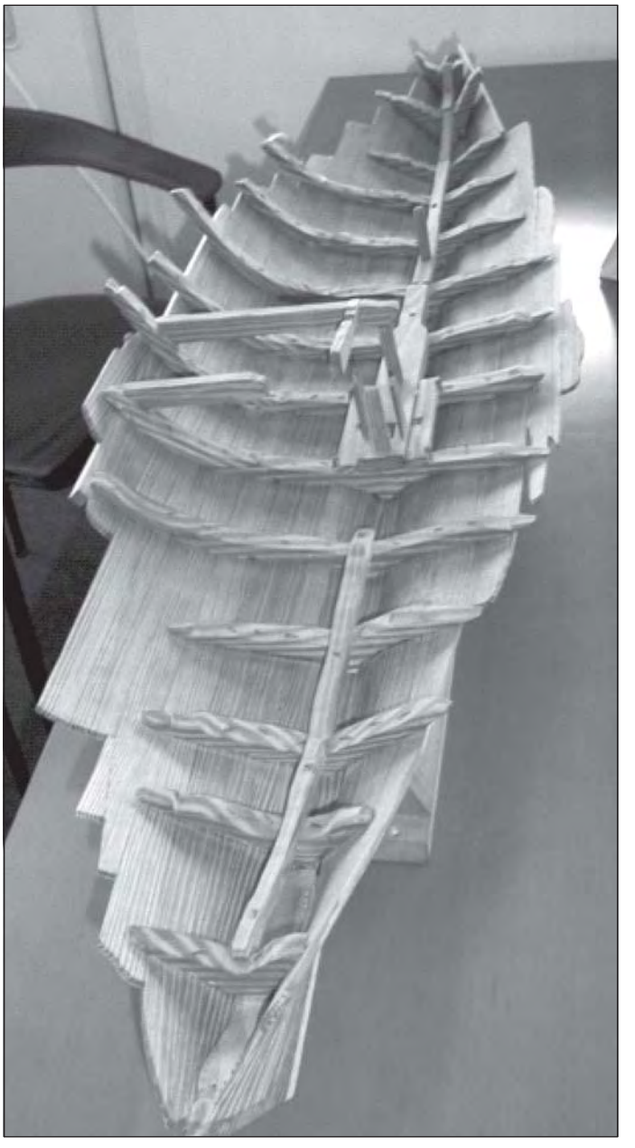


Fig. 1. A 1:10 model of the MM ship (built by J. Udell)

This fixed the ship's height amidships and established that the bow curved slightly outwards and the stern curved slightly inwards. Information available from two ships from a similar period: the *Kyrenia* and the *Jules-Verne 7*, was also incorporated.

In addition, a 1:10 model was built of one side of the ship, to evaluate its form and proportions, and to aid in establishing the body lines. With the help of this model, the bow and stern were shaped to the final proposed height. The missing portion of the shell was completed by using stretched threads to represent the missing strakes. The results were transferred onto paper to reproduce a planking pattern, a vital basis for building the replica.

When the hull lines were fully established (Fig. 2), two hydraulic analysis methods were used to test the design. The first one compared the form coefficients at five different heights with those of the *Kyrenia* and the *Jules-Verne 7*. The results for the suggested hull design were both reasonable and logical. The second and most crucial test was to examine the stability of the proposed ship design, considering her cargo, 13 tons of rocks according to the archaeological evidence. The results were very satisfactory and showed that the Ma'agan Mikhael would have met today's standards.

The results of this study conclude that the external form of the Ma'agan Mikhael ship originally had the following characteristics:

Overall length: 14.4 m, beam: 4.24 m, height amidships: 2.6 m. The bow curved slightly outwards and reached a height of 3.6 m, while the stern curved slightly inwards and reached a height of 3.2 m. The ship had 18 strakes, including 3 wales and a gunwale.

Seaworthiness tests, assuming draft 1.4 m; freeboard 1.2 m and sail area 48 m^2, gave the following results:

– Range of positive stability 70^0.

– The ship could have sailed in seas with waves reaching 2 m, and winds up to 21 knots (Beaufort 5), gusting up to 27 knots (Beaufort 6).

Adina Ben Zeev

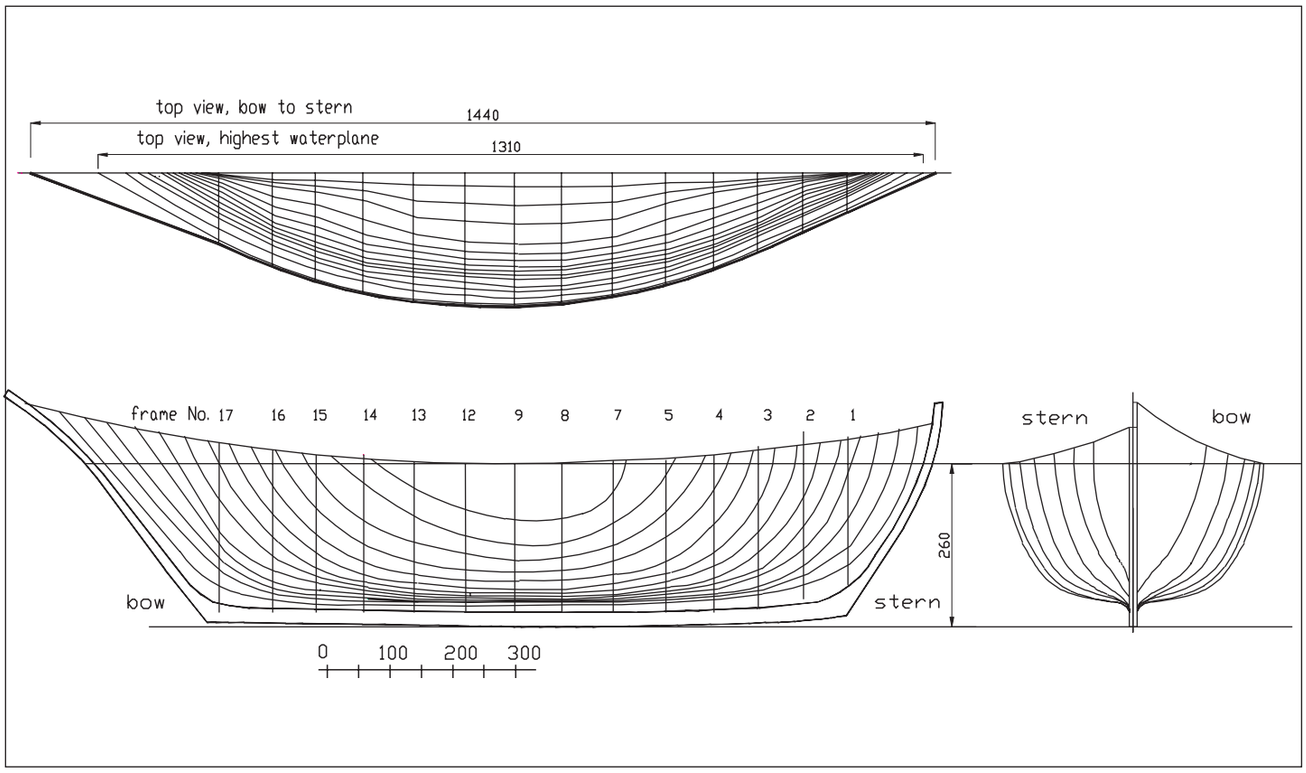


Fig. 2. The hull lines of the MM ship

"A JOURNEY THROUGH THE ROUTES OF THE LEVANT COAST" – SCIENTIFIC NAUTICAL CHARTING OF THE COASTLINE & SHALLOW LEDGE OF THE LAND OF ISRAEL (PALESTINE) IN THE 18TH & 19TH CENTURIES

For thousands of years the Mediterranean Sea has served three continents — Asia, Africa and Europe — for the exchange of goods, concepts and cultural links. The evolution of seaports provides one of the most enlightening topics in the history of the relationship between mankind and the sea. The history of a seaport, like the history of a ship, reflects adaptation to social and economic change, and is the manifestation of impressive technological accomplishments.

There is no knowledge of orderly methodical scientific cartography of the Land of Israel (Palestine) generally, and charting of its shores in particular, until the late 18th and early 19th centuries. However, during that period, scholarly Biblical learning was a highly respected pursuit in Victorian England and the western world in general, leading to exploration of specific places, such as Jerusalem, Bethlehem and Nazareth. However, recent studies differ on the actual influence of geo-religious concepts on organized research and the cartography of the Land of Israel and its shores.

It seems that the Land of Israel was not considered sufficiently important to justify trigonometrical measurement and surveying, which would have required the investment of substantial financial and organizational resources. This was not done until much later.

In the light of this, the question was what mapping/charting was carried out along the shores of the Land of Israel to provide seamen with the tools that would safely lead them to their destinations? The following general research objectives were specified to find the answer:

1. To present the sequence of the evolution of nautical charting along the Israeli coast, from Gaza to Tripoli, Lebanon (The Geographical Space), from 1770 to the British Admiralty survey of 1862 (The Time Frame).
2. In the context of the above, to attempt to discover previously unknown published nautical maps/charts of the coast.
3. To analyze the evolution of cartographic techniques and the accumulation of data.

These objectives were achieved by providing answers to the following specific questions:

1. How did the charting of the coastline evolve during the period in question, which is the primary period in the history of the geographical study of the Land of Israel? What were the geopolitical factors and motives behind the various initiatives regarding the nautical charting of the Land of Israel?
2. Who were the cartographers, and on behalf of which organizations did they operate? What was the effect of the technological evolution of nautical charting/cartography in those days on the charting of the coastline?
3. What were the objectives of the charting efforts? Did these objectives change over the years, and in what way? Was there a link between the evolution of nautical charting and the geographical exploration of the Land of Israel during this period?

Several European navies – the French, Austrian, Russian and Spanish, were involved in nautical charting of the Mediterranean Sea in the last quarter of the 18th century: At first, it was the Russian Navy that endeavored to gather information about the Eastern Mediterranean, even though it was only considered a secondary theater of operations. Information gathered by Russian seamen during the 'First Archipelago' expedition (1769—1774) was subsequently used in the creation of nautical charts for three different Mediterranean ports: Beirut, Sidon and Haifa (Fig.1.)

The area of Cape Carmel was surveyed in 1798, by Brigadier Don Felipe Lopez de Carrizosa of the Spanish Navy, in the frigate 'La Cecilia'. The Spanish Brigadier Don Dionisio Galliano conducted a hydrographic survey of the Mediterranean between 1802 and 1803. During this voyage, the locations of the ports of Latakia, Tartus, Tripoli and Sidon, as well as the northern tip of the Bay of Acre, were surveyed and charted.

The knowledge of the Syrian coastline in those days may have been based on the astronomical-nautical operations conducted by the French Navy in the years 1816-1817. It began as a comprehensive study of the Mediterranean Sea by Captain Gautier, on board the frigate 'Gabare la Chevrétte', and was continued, totally independently, by Captain Hell, on board the frigate 'La Galette'.

These early initiatives notwithstanding, the Hydrographic Service of the British Royal Navy became the undisputed leader of nautical charting in the Eastern Mediterranean during the 19th century. Immediately following its establishment, the Service embarked on the methodical charting of the Mediterranean. Initially, areas of the central Mediterranean were surveyed and charted, and the charting effort was subsequently extended eastward. Between 1811 and 1812 Captain Francis Beaufort was dispatched to survey the southern shores of Turkey (Coast of Karamanie).

During the early 1830s, the British initiated a massive effort of mapping the main land routes leading from the Levant coast to the Persian Gulf and the Red Sea. In the context of this effort, Francis Rawdon Chesney surveyed and

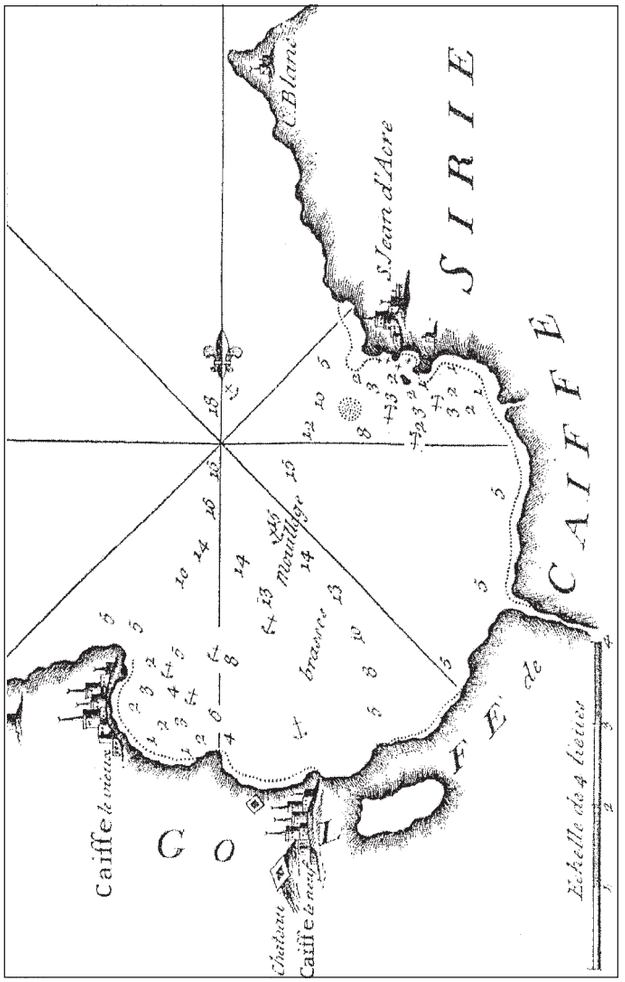


Fig. 1. Haifa Bay (Allezard, J., 1800, 63a-63b)

charted the seaports of Syria. In summer of 1840, a British Squadron had been ordered to cut off all communication by sea between Egypt and Syria, and a portion of it, with some Austrian frigates, appeared off Beirut on August 11, 1840. A group of engineers from the Royal Sappers and Miners Corps joined the military expedition and, among other things, carried out a meticulous survey of the coastline.

In 1856, Arthur L. Mansell was dispatched to survey the Egyptian coast. In 1860, he began exploring the Land of Israel, a substantial geographical effort that was concluded in 1862. Through this enterprise, the coastline was explored and revealed for the first time almost in its entirety, as it actually was – largely a straight, uninterrupted line, without the imaginary bays and inlets that had been depicted until that time near every ancient town and seaport, and which had been used to 'liven up' the coastline. Mansell's important work, subsequently served as a knowledge base for the Admiralty's charts of the Eastern Mediterranean. It would never have materialized without the 'life and soul' that had personally sponsored this project; Rear Admiral John Washington, who, in 1855, succeeded Beaufort as Chief Hydrographer of the Royal Navy. Washington even joined Mansell, in September 1860, for comprehensive excursions in the Land of Israel, Syria and Lebanon, following which he concluded that organized, methodical surveying of the Holy Land and its northern neighbors was required. This surveying project was executed between 1871 and 1877, following the establishment of the Palestine Exploration Fund.

The evolution of the charting of the Levant coast was influenced by cultural and scientific processes in the academic world and within the royal families of Europe, as well as by geopolitical processes mainly driven by economic interests.

The factors and reasons that motivated world powers such as France, Great Britain and Russia to dispatch fleets to the shores of the Levant were complex and highly diversified. They involved political, economic and national security interests, mainly concerned with one primary factor — the route to India.

It may be stated that scientific charting of the Levant coastline began in the 1860s, when handbooks of seaport charts were published for the benefit of sea captains. Nautical charts had evolved into a scientific tool whose quality steadily improved during the 19th century. This process may be attributed to the significant improvement of the various measurement and surveying instruments, to the establishment of the British Hydrographic Office, and to the appointment of Francis Beaufort as its head. Beaufort issued an elaborate system of procedures and regulations, and specified detailed quality criteria for the various products.

As nautical surveying/charting voyages were extremely expensive, military expeditions were often used, among other things, for cartographic surveys. Both the Russian Navy and the British Royal Navy issued standing orders to address this particular subject.

This research specifically contributes to the study of charting the Levant coastline and seaports on the basis of measurements from the sea — a subject that has not previously been sufficiently explored.

Nissan Seffen

BASE-RING WARE FROM TELL ABU HAWAM — EXCAVATION 2001

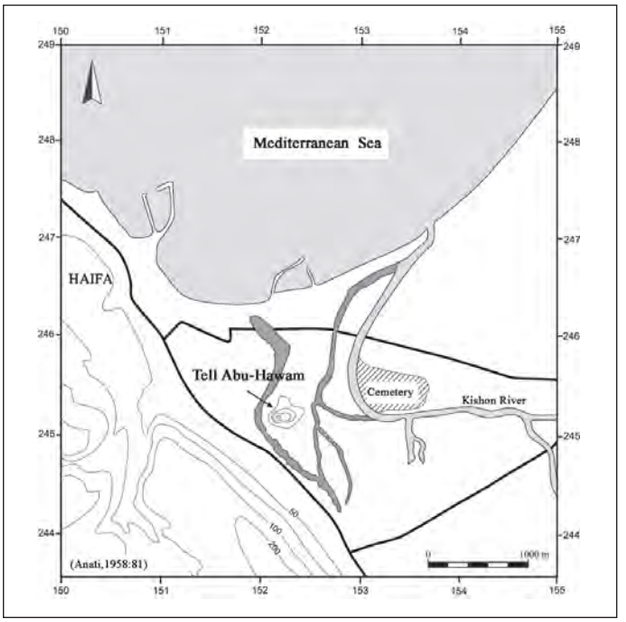


Fig. 1. Tell Abu Hawam - location map (Anati, 1958: 81)

A central topic in the archaeological research of the Late Bronze period is trade among Mediterranean countries. Cypriot Base-Ring ware was one of the most widely distributed ceramic products in the Levant in the Late Bronze Age. Stylistic variations in this ware have raised questions about its centers of production and export destinations.

The object of this study was to identify the centers of production of the Base-Ring ceramic ware found in the 2001 excavation of Tell Abu Hawam (Fig. 1). In the Late Bronze period, Tell Abu Hawam was an island or peninsula. The site served as a port and trade center for the Aegean, Cyprus and the Levant, and, to a smaller extent, Egypt. Although Tell Abu Hawam has been excavated many times since 1920, there are still differences of opinion among scholars about its nature. Layer V is Late Bronze, the dating of which is still an open question, although the 2001 excavation has strengthened the hypothesis that this layer is dated to the 14th century BCE and later.

The 2001 Tell Abu Hawam salvage excavation was in the northeastern section of the site, in an area considered to be an anchorage. The ceramic finds in this excavation included a high percentage of imported ware, with a large number of Base-Ring sherds (Fig. 2). Examples of a wide typological variety of these finds were taken for petrographic analysis to identify their mineral content. The geological sources of these minerals located the production area for the sherds.

The petrographic analysis resulted in remarkably homogeneous results in both matrixes and inclusions. This indicated that the Base-Ring ware was produced at a single location, or several locations in the same area of clay deposit. The ware fabric was characterized by argillaceous rock and siltstone. Layers of clay embedded with marl, limestone, and siltstone are common in the Pakhna formation, and appear also in the Lefkara formation. Analyzing sites located on these formations, checking petrographic analyses of other Cyprus Base-Ring ware, and inspecting tablets from major coastal settlements, led to the conclusion that the Base-Ring ware found in Tell Abu Hawam was probably produced in the Hala Sultan Tekke or Maroni areas located on the east coast of Cyprus.

Ofra Barkai

Fig. 2. A selection of Base-Ring ware found at Tell Abu Hawam (Photo: M. Artzy)

PEN-NETS IN THE GULF OF EILAT AND THE ROOTS OF MARINE ECOLOGY IN ARISTOTLE'S WRITINGS ON ANIMALS

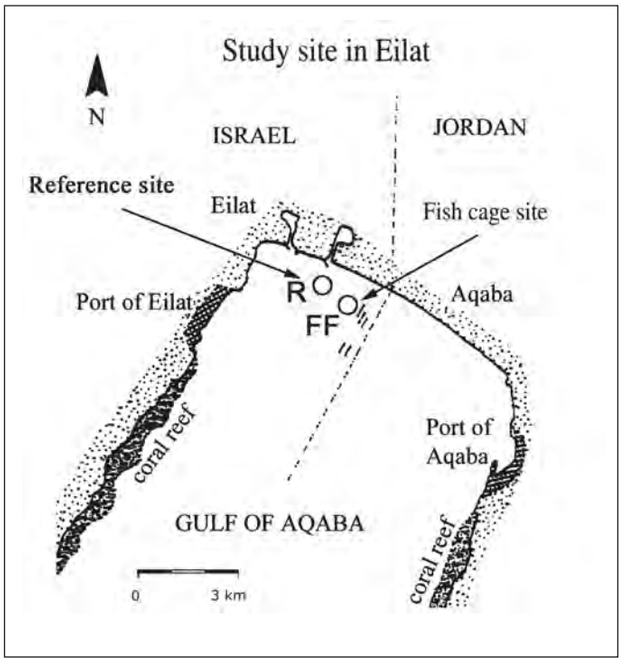


Fig. 1. A location map of the Fish Farm studied (FF) and Reference (R) sites in Eilat, the northern Gulf of Aqaba, Red Sea, (Adapted from Eden et al. 2003).

Natural history is considered to be one of the roots of modern ecology and Aristotle is regarded as its founder. In the present work, his essays *Historia Animalium* and *De Partibus Animalium* were analyzed. Texts describing aquatic ecological concepts were cited and classified into modern ecological categorizations. Ecophysiology and behavioral ecology comprise the main part of Aristotle's marine ecological research. The list of species that exemplify these themes consists of sponges, sea anemones, crustaceans, lobsters, bivalves, cephalopods, fishes, cetaceans and seals. The life-history and characteristics of many of the species in these groups are described in detail and include: season and mode of generation, breeding strategies, copulation, habitat selection, feeding characteristics, and defense mechanisms. Their reaction to changing physical or chemical conditions (temperature, salinity, waves, moisture, as well as the algal content of water) is also described.

Aristotle's approaches to study may be referred to as descriptive and causative (the latter developed into the evolutionary approach). "...there are more causes than one concerned with the formation of natural things: there is the cause for the sake of which the thing is formed, and the cause to which the beginning of the motion is due" (*DP* I 639b7). Aristotle answers this by using the principles of ecological harmony. An animal cannot be distinguished from the forces that shaped it; it is a manifestation of nature. Its behavior and physique is influenced by nature.

In Aristotle's view mankind is part of a natural harmony. Today, opinions differ as to whether or not man is part of the natural environment. With the human population continuously growing, the demand for food increases and this demand exerts its influence on both the terrestrial and aquatic ecosystems. In the aquatic ecosystem it results, amongst other things, in reduced fishery catches and a growing mariculture industry.

Mariculture-derived organic enrichment is a common disturbance of marine communities, causing local disruption to the sediment and water column. It consequently changes the communities of phytoplankton, bacterioplankton and subsequent secondary producers which, in turn, can affect grazers and predatory communities. This loading may then lead to environmental problems such as sediment anoxia, algal blooms and a reduction in biodiversity. The effects can be particularly detrimental in the oligotrophic Red Sea where an increase in the supply of nutrients to the photic layer may cause the death of corals due to an intense growth of macro algae on top of them. Macro-fauna that thrive in an organically enriched environment benefit from nourishing on the detrital content of the water column near the fish cages. They may additionally feed on the bacteria and plankton content that flourish following enrichment.

A growing concern over the future of the coral reefs in Eilat, the northern Gulf of Aqaba, Red Sea, attributed, among other sources, to aquaculture-derived organic enrichment, led to study the development of sessile macro-biota community on mid-water artificial substrates, as a means of reducing the organic loading through bioaccumulation. An artificial vertical substrate was deployed 10 and 300 m west of the Ardag fish farm (Fig. 1). The artificial substrate comprised of 20 mm P.V.C mesh (Fig. 2). Sessile macro-biota was sampled bimonthly at a depth of 8 m during the 11-month study. The communities which developed at 3, 8, and 14 m depths were sampled and compared 11 months after deployment. Species specific percent cover, dry and ash free dry biomass were measured. Samples of colonizing organisms were also taken for assessment of stable isotopic composition and comparison with seston and fish feed isotopic composition, in order to trace the sources of nutrition. Water was sampled monthly from both sites at 8 m depth and

Fig. 2. One array of cylinders, shortly after deployment, Eilat, the northern Gulf of Aqaba, Red Sea, at 8 m depth (Photo: S. Breitstein).

dissolved inorganic nutrients (including: nitrite + nitrate, total phosphorus and silicate) were analyzed. The data was analyzed using univariate and multivariate statistical tests.

Throughout the study period and at all depths, Site FF (fish farm) was characterized by a significantly higher species richness and diversity than at Site R (Fig. 3). Percent cover and dry and ash free dry biomass were also significantly higher at the fish farm (FF) site than at the reference (R) site. The results of the different indices: percent cover, dry weight and ash free dry weight, generally cohered. At FF recruitment continued and diversity increased during the first 9 months and the community showed a continuous change with time, defining three distinct communities. Whilst at R, recruitment that occurred mostly at the beginning of the study period resulted in the increasing dominance of few species and decrease in diversity with time. Dominant taxa (taxa that constituted over 20% of dry biomass at any of the sampling dates) were: the red algae *Jania adhaerens* and the demosponges *Mycale fistulifera*, sea anemone *Aiptasia pulchella*, micro serpulid polychates *Salmacina* sp. & *Josephella marenzelleri*, colonial ascidians *Didemnum* sp1, the bryozoans *Celleporaria aperta* and *C. columnaris* and 'beige sponge 1'. At R, the dominant taxa were: *M. fistulifera, J. adhaerens*, *C. aperta* and bivalves *Dendostrea frons* and *Streptopinna saccata*, and ascidian *Styela truncate*.

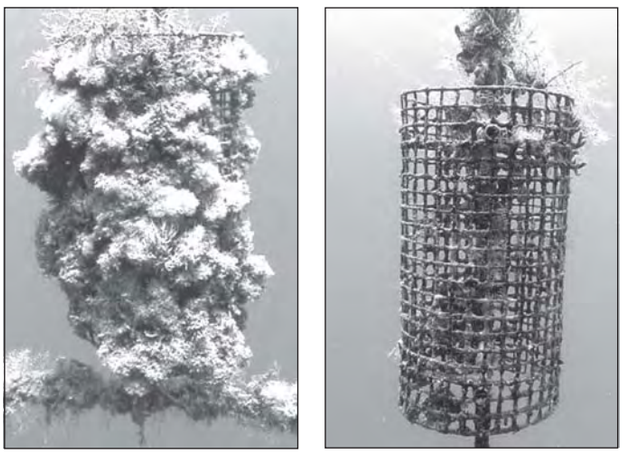


Fig. 3. Example of typical cylinders and their biotic coverage, 11 months after deployment (June 2002) from FF (left) and R sites (Photo: S. Breitstein)

At FF species richness and diversity was similar at 5 and 8 m depth, and comprised of the same groups: macro-algae, encrusting sponges, colonial ascidians and bryozoans, but of different species. At a depth of 14 m the indices values were significantly lower. At R, species richness and diversity didn't vary significantly with depth. Water quality at the two sites was similar, apart from a significantly higher concentration of silicate at R. Other nutrient concentrations were similar to other coastal stations, but significantly higher than their concentrations in Open Water stations. The latter results may be attributed to one or more of the following explanations: high rates of flushing at the open water station, a local depletion of silicate at FF, and the concurrence of more pollution sources at the northern coast of Eilat.

The taxa that succeeded at the FF site, macro-algae, encrusting sponges, colonial ascidians and bryozoans, often exceeded 100% cover. These groups are known to predominate on vertical cliff faces exposed to sewage pollution as well as to prevail in cryptic coral reef habitats. Lojen, who assisted in determining stable isotopic composition, estimated that 61% of the food consumed by the suspension-feeders found at FF was derived from the fish cages. It may be that the oligotrophic nature of the Red Sea naturally limits growth of the detritus-feeding organisms identified on the artificial substrates at Site R. The changes in communities on both sites over time may be attributed either to early succession phases or to the development of a community unique to a heterotrophic 'island' in the oligotrophic Red Sea. The demosponge *Mycale fistulifera*, dominant at both sites, possesses high filtering capabilities. Yet, the bioaccumulation provided by the entire community at the peak of its biomass, 9 months after deployment (MAD), is minor compared with the organic output of the fish farms during this period and thus, can only provide a partial solution, at best.

Anat Tsemel

PALYNOLOGICAL RECONSTRUCTIONS OF LATE QUATERNARY CLIMATIC CHANGES IN THE CARMEL COAST OF ISRAEL

The end of the Quaternary is characterized by significant climatic changes, which effected the fauna, flora, landscape and human settlement patterns and culture. This research aims to reconstruct the paleoenvironmental conditions in the Carmel coastal plain during the last ~ 26,000 years. The study is based on stratigraphical and palynological analyses of a core (hereafter 'D-Dor') that was drilled as part of this research in the coast of Dor.

Two luminescence (IRSL) age determinations were obtained for the upper sand unit (from sea level up to 6.30 m below surface), while the clay units (6.30-10.5 m) were radiocarbon dated. X-ray radiographs of the clay cores enabled precise sedimentological evaluation (Fig. 1). The stratigraphic data included identification of organic and biogenic material, as well as identification of bedding and structures. The core was subsequently sampled for palynological analyses in sequential intervals of 10 cm. Pollen grains from each sample were extracted, identified and counted and the pollen spectrum constructed.

Three clay units were identified, overlying *kurkar* (calcareous sandstone) and covered by sands: The bottom clay unit is a paleosol. Pollen was not preserved in this unit. Gray clay (the top of which was dated to about 12,000 cal. YBP) was deposited, overlying the paleosol, in a wetland environment. Pollen was preserved only in the upper part of this unit. It indicates a slightly drier climate than today's, probably correlative with the Younger Dryas. At the beginning of the Holocene, between 10,300 and 9,550 cal. YBP, a new marsh originated, depositing dark clay. High concentrations of well-preserved pollen allowed the reconstruction of several fluctuations in humidity. When the marsh was first formed, precipitation was higher than today, and oak maquis was more extensive in the area. The occurrence of several tree species (i.e., *Corylus* sp., *Carpinus* sp. and *Juglans* sp.), which do not grow naturally in the area today, indicates slightly lower temperatures than today. Around 5,000 years ago sand began to accumulate in the region as a consequence of the Holocene sea level rise, covering several submerged prehistoric settlements off the Carmel coast that were embedded in the upper part of the dried Early Holocene marsh.

Dafna Kadosh

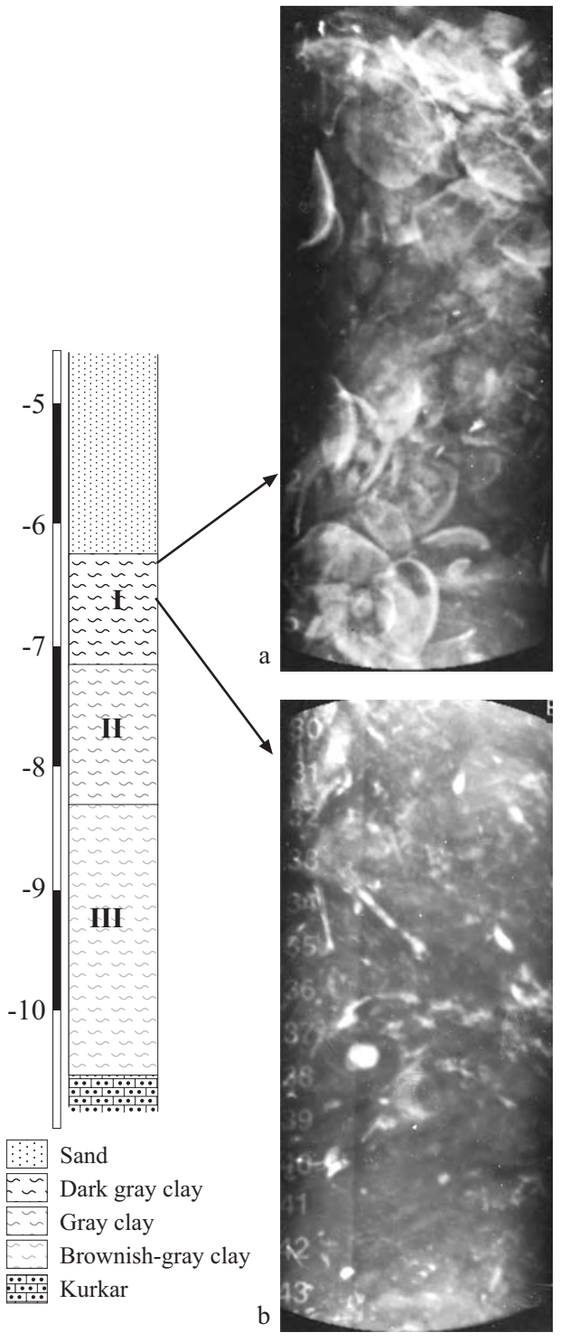


Fig. 1. X-ray radiographs within the general sequence:
a - from a depth of 6.33 - 6.55 m, which include marine shells, mainly Glycymeris.
b - from a depth of 6.60 - 6.73 m. Note the various structures

FISHES CAUGHT IN THE ELECTRIC COMPANY'S HAIFA POWER STATION'S FILTERING SYSTEMS IN RELATION TO ENVIRONMENTAL CONDITIONS AND IN COMPARISON TO FISH ASSEMBLAGES FROM ANCIENT COASTAL SITES

Most of the power stations belonging to the Israeli electric company are located on the Mediterranean coastline and pump a considerable amount of seawater to cool the turbines. Filters are placed in the intake cooling system canals in order to prevent the infiltration of foreign objects. These filters also constitute a means for collecting fish samples.

The goals of the research were to find a correlation between the environmental conditions and the amount and characteristics of the fishes captured in the filters of the Haifa power station as well as to compare between the assemblage of fishes at present and the assemblages of fish bones' remains from the ancient coastal sites: Tell Abu Hawam, Caesarea and Tell Kabri. Twice a month, over a period of 12 consecutive months (December 2002 to November 2003), the filters at the Haifa power station near the Kishon River outlet were examined (Fig. 1). The fishes were sampled, classified, counted, weighed and the total length (TL) of each fish was measured.

In addition, the following environmental data was obtained and measured: air and water temperatures, water salinity and PH levels, wind direction and strength, wave height, direction, frequency and velocity, sea state, sea levels, precipitation, % of humidity in the air, condition of the fishes and hydrological data from the Kishon.

Fig. 1. Examining the filters at the Haifa power station (Photo: K. Abrahamson)

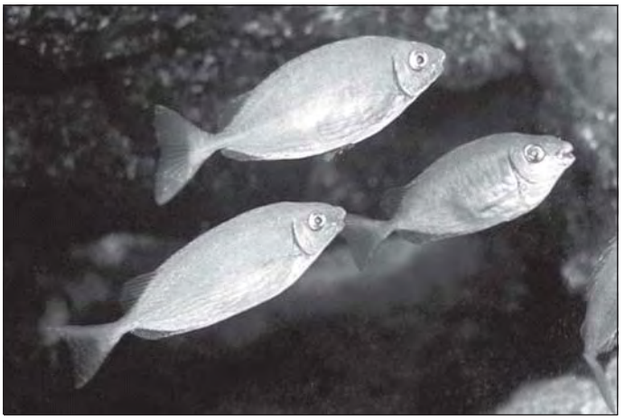


Fig. 2. Siganus rivulatus, one of the species sampled (Turkishfishbase.org)

During the 24 days of sampling, 1992 fish specimens were sampled with a total weight of 81.7 kg belonging to 45 species from 25 families. The most common species were the spotback herring*, Herklotsichthys punctutus*, the thinlip gray mullet, *Liza ramada,* the marbled spinefoot rabbitfish*, Siganus rivulatus* (Fig. 2)*,* the European anchovy, *Engraulis encrasicolus,* the round sardinella, *Sardinella aurita,* the white sea bream, *Diplodus sargus* as well as representatives of the Cichlidae family (St. Peter's fish). The highest number, biomass and species richness, were recorded in the winter and spring. From the 45 species of fish, 12 (27%) of the species were migrants from the Red Sea (Lessepsian migrants), as compared with 14.2% Lessepsian fish species in the southeastern Mediterranean Sea. Also 50% of the total specimens caught were migrants from the Red Sea (1004 Lessepsian specimens from a total of 1992 specimens caught).

A significant positive correlation was found between sea conditions, and the number (and weight) of the fishes caught in the filters. A significant negative correlation was found between the water temperature and the number and weight of the fishes. We assume that in a rough and cold sea, during winter storms, many fish species find shelter in the calm cooling water basin of the power station and are then pumped into the filters together with the water. The number of fish species tended to be inversely proportional to the water temperature. It is possible that in winter, fish are attracted to the general area of the power station due to the warm coolant water that is released north of the cooling water basin.

A significant negative correlation was found between fishes belonging to the Cichlidae and Mugildae families (families that are found in or penetrate to freshwater) and water salinity. No correlation was found between the general number

of fish specimens and their weight to that of unusual flooding events that took place in the Kishon during the present study.

Based on the bio-mass captured during 24 sampling days at the Haifa power station, if indeed the fishes captured in Haifa reflect the situation at the rest of the stations and are not unique to the Bay of Haifa, a national annual evaluation of all the marine power stations would reveal a considerable bio-mass (34 tons of fish apart from various invertebrates) which is taken out of the water and is not exploited. Therefore, it is recommended to find solutions that would reduce the number of fishes caught in the power stations filters. These solutions would be useful to the electric company, for whom the fish carcasses present a nuisance, as well as for the fish population.

The number of species of fish found, their weight and numbers in the different seasons during the research year (2003) were compared to the findings of two studies where fishes caught in the filters during 1999 (Glazer) and in the cooling water basin in 1995 (Chaout) were examined. A statistically significant difference was found between the weight and number of species caught during each of the years 1995, 1999 and 2003. The mean weight and number of species in 2003 were much higher in relation to the other findings. The fact that the present research year was relatively very stormy and rainy may explain these differences.

Great similarity was found between the fish species diversity that exists today at the power station to that found, based on bone remains, at Tell Kabri. In contrast, species diversity found at Caesarea was lower than that found at Tell Kabri and the power station. In comparing the present number of fish families and species to findings at the sites of Tell Kabri, Caesarea and Tell Abu Hawam, there is a clear difference in the number of species today, which is 4 times the number at archaeological sites. On the other hand the number of families today is only slightly higher than at archaeological sites. Most of the species of fish identified from the bone assemblages at Caesarea, Tell Kabri and Tell Abu Hawam are that of edible fish, in other words fishes brought there for the purpose of consumption and therefore contain more open sea fishes. This data strengthens the assumption that they reflect kitchen waste.

Edna Ethad

Two of the boats under full sail

Cnidos – Students learning about the site

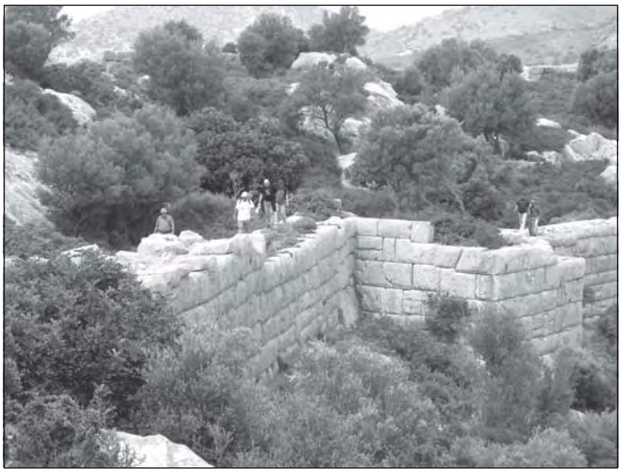
Approaching Bodrum Castle

THE 2005 STUDY TOUR TO TURKEY

The 2005 study cruise was devoted this year to the Ionian coast of Western Turkey, from Izmir (Çesme) to Marmaris. The 32 students and lecturers, who sailed aboard four yachts, enjoyed a rich program of site visits and lectures. The cruise proved again to be a crucial activity in the Department's program, giving the participants the experience of sailing, combined with a thorough study of the region and its numerous maritime and coastal sites.

Our thanks go to Sir Maurice and Lady Irene Hatter, who by their generous donation made this successful and rewarding tour possible.

Photos: N. Kashtan



The Hellenistic walls at Lorima

The four boats anchored at Lorima

NEW PUBLICATIONS

THE MA'AGAN MIKHAEL SHIP

The Recovery of a 2400-Year-old Merchantman

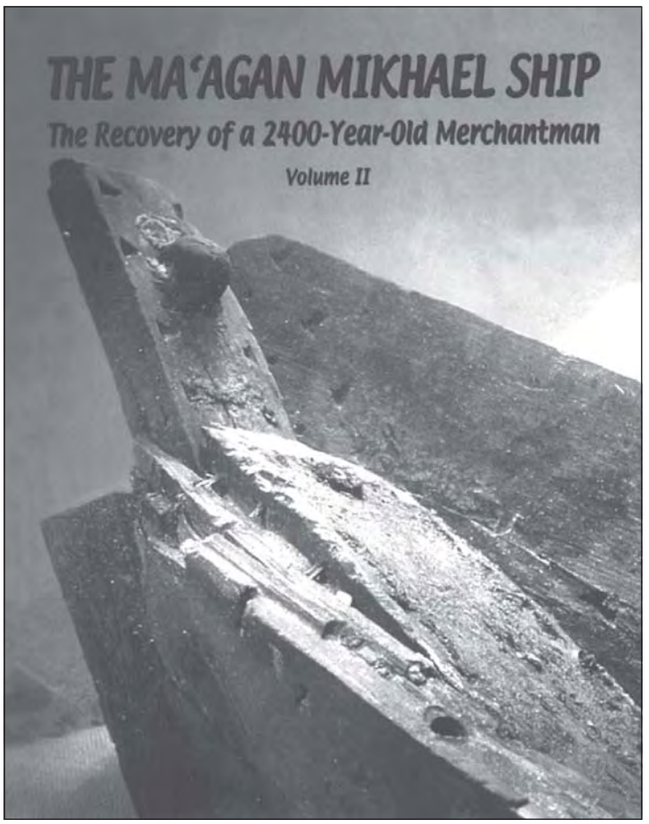
Volume II

Yaacov Kahanov and Elisha Linder
Israel Exploration Society
and the University of Haifa, 2004.
ix + 302 pp. With many illustrations
Edited by John Tresman
ISBN 965-221-055-2

Volume II of the final report continues and complements Volume I. Its five chapters focus on various technological features of the ship's hull construction, but several other topics are also included. Some of the sections were written by students of the Department of Maritime Civilizations.

Chapter 1 by Y. Kahanov, deals thoroughly with the Sewing of the Ship.

Chapter 2 comprises studies of features of the hull: I. Yovel contributes three studies: The Typology of Copper Nails, Tenons, and Limber Holes. Another student, I. Jabour, writes on Tapered Pegs, while Y. Kahanov deals with Mortise Analysis. Two laboratory analyses are reported; Putty-like Material by M. P. Colombini, G. Giachi, P. Pallecchi and E. Ribechini of the University of Pisa; and Analysis of Paint by J. Glastrup and T. Padfield of the National Museum of Denmark.

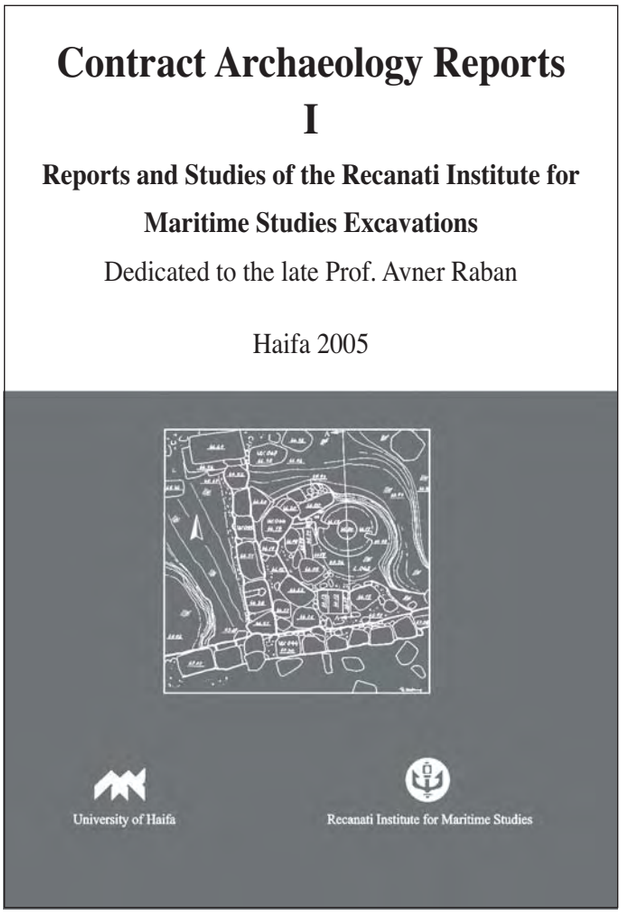


Chapter 3 deals with wood: A. Hillman and N. Liphschitz report generally on The Wood. Analyses of the tree species (Dendroarchaeological Investigation), is presented by N. Liphschitz, who uses the location of tree growth to hypothesize the route of the ship. The Carpenters' Tool Marks are studied by H. Mor, and Y. Sitry writes on Unique Wooden Artifacts.

Chapter 4 by Y. Kahanov, describes the Conservation of the Ship's Timbers.

Chapter 5 comprises miscellaneous topics: Reassembly of the Hull by G. Votruba, Ceramic Provenance — NAA by J. Yellin and M. Artzy, E. Linder analyzes the Biblical Metaphor of Tyre, and Kahanov and Linder conclude the volume.

The Volume is dedicated to the previous president of the University of Haifa, Y. Hayuth.



The first volume of reports dealing with the archaeological salvage excavations carried out by the Recanati Institute for Maritime Studies has been published. This publication was edited by Michal Artzy and Shalom Yanklelvitz. Technical editing was carried out by Gil Zioni and the graphic editing by Noga Yoselevich. The publication is dedicated to the late Prof. Avner Raban who was the leading force behind the Institute's involvement in salvage archaeology.

The reports also appear in electronic format which can be found at: http//:excavations.haifa.ac.il

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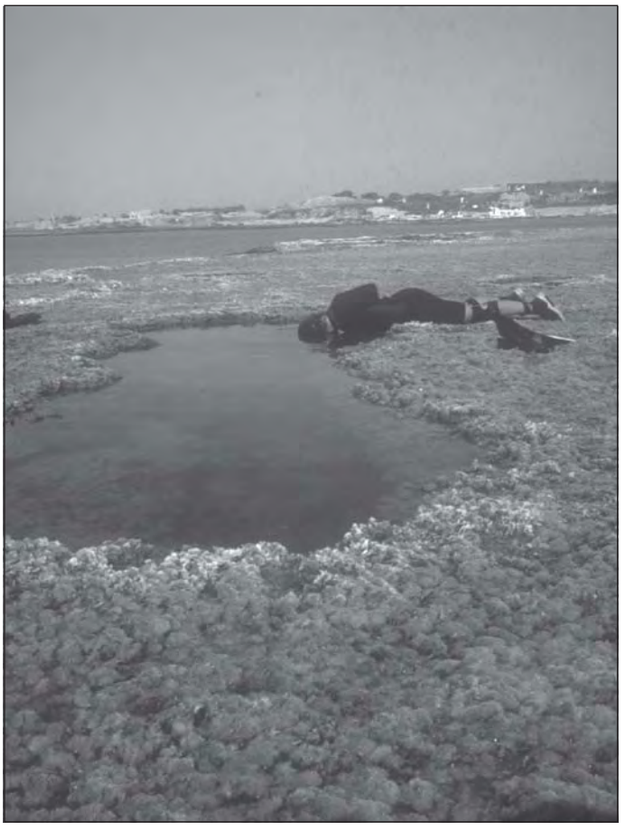

'Dry diving' at low tide (Photo: M. Fine)

A storm at Haifa beach, Winter 2005 (Photo: Y. Tur-Caspa)

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A storm at Haifa beach, Winter 2005 (Photo: Y. Tur-Caspa)

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Front Cover: Fish-eye view – two worlds (Photo: I. Grinberg)

Back cover: Coral reefs are the most diverse ecosystems on the planet populated by thousands of species of organisms. This unique ecosystem is under threat due to natural and anthropogenic stressors. Reefs such as the reef in the photo (GBR, Australia) might disappear within a few decades if global warming trajectories are accurate (Photo: M. Fine).