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**The role of the sea in the life of the people of Crimean Cherson**  
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#### Titelmotiv

*Rom, Trajanssäule Szene XXXV.*  
*Frachtkahn.*

*Aus: S. Settis et al., La Colonna Traiana,*  
*(Turin 1988)*

*Vgl. : Octavian Bounegru ,*  
*Naves frumentariae, Abb. 3.*

# Submerged prehistoric settlements off the Mediterranean coast of Israel

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Baruch Rosen – Israel Hershkovitz

**Abstract** – Inundated archaeological sites dating from the Middle Paleolithic to Pottery Neolithic periods were exposed off the Carmel coast of Israel. The bulk of the sites represent *in situ* Neolithic settlements dating to 9250 to 6600 cal. BP, while the pre-Neolithic sites represent ephemeral flint artifact concentrations. The earliest *in situ* site, the late Pre-Pottery Neolithic (PPNC) village of Atlit-Yam, yielded human burials (including the earliest known case of tuberculosis), rectangular stone structures and megalithic structures as well as stone-built water wells. The wells exploited coastal aquifers and permitted permanent human habitation on the coastline for the first time in this region. Subsistence was based on a combined agro-pastoral-hunting-fishing mode of production. The later Pottery Neolithic (PN, Wadi Rabah culture) sites comprised domestic structures, installations and water wells built of wood and stones. At the Neve-Yam PN site, the earliest separate burial ground in the region was found with stone-built graves. The PN economy was engaged in animal husbandry, fishing and cultivation of domestic crops. The beginning of olive oil extraction, a major component of the Mediterranean subsistence, is demonstrated at the PN site of Kfar Samir. Together these submerged Neolithic sites on the Carmel coast, track the emergence of the earliest Mediterranean fishing villages in the southern Levant.

**Inhalt** – Überflutete archäologische Fundstellen aus dem Mittelpaläolithikum bis zum keramischen Neolithikum sind vor der Carmel-Küste Israels freigelegt worden. Die Masse der Fundstellen stellen neolithische *in situ*-Siedlungen der Zeit von 9250 bis 6600 cal. vor heute, während die vorneolithischen Plätze ephemere Ansammlungen von Feuersteingeräten sind. Die früheste feste Siedlung, das Dorf von Atlit-Yam aus dem späten vorkeramischen Neolithikum (PPNC), ergab menschliche Bestattungen (mit dem ältesten bekannten Tuberkulose-Fall), rechteckige steinerne Anlagen und megalithische Bauten sowie steinerne Brunnen. Diese nutzten küstennahe Wasseradern aus und ermöglichten erstmals in dieser Gegend ständiges menschliches Leben an der Küste. Eine Verbindung aus Acker- und Weidewirtschaft sowie aus Jagd und Fischfang sicherte das Dasein. Die Fundplätze des späteren keramischen Neolithikums (PN, Wadi Rabah-Kultur) weisen Hausbauten und Brunnen aus Holz und Stein auf. An der PN-Fundstelle Neve-Yam fand sich der älteste gesonderte Bestattungsort der Region mit steinernen Gräbern. Die PN-Wirtschaft betrieb Viehzucht, Fischfang und Feldbau. Der Beginn der Olivenölgewinnung, eines Hauptbestandteils mediterraner Verpflegung, zeigt sich am PN-Platz Kfar Samir. Insgesamt lassen uns diese versunkenen neolithischen Fundstellen an der Carmel-Küste das Entstehen der frühesten mediterranen Fischerdörfer in der südlichen Levante verfolgen.



## 1. Introduction

The Mediterranean coast of Israel is ca. 190 km long, trending north-south in northern Israel and north-east to south-west in southern Israel. It is slightly curved with mostly sandy beaches in the south, coastal erosional cliffs in the centre and some rocky areas in the north along the Carmel and Galilee coasts. Scanty traces of Middle Paleolithic and Epi-Paleolithic submerged sites have been recovered in southern Carmel coast of central Israel (Fig. 1a), while six sub-

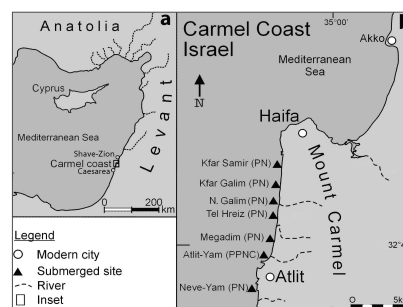


Fig. 1: Location map, a) the Israeli coast, b) submerged settlements off the Carmel coast.

merged Neolithic settlements have been discovered in a 12 km long

strip along the northern Carmel coast (Fig. 1b). The sites were inundated following the post-glacial sea-level rise.

The Neolithic settlements off the Carmel coast are embedded in a distinct layer in the upper part of a palaeo-soil (Galili 2004). Due to sea-level rise (Galili et al. 1988, 2005), the existence time of each site was relatively short and there were no earlier or later occupation phases. Thus, the mixing of layers and post-deposition disturbances were minimal. Post-inundation,



the sites were overlain by a layer of sand that protected them, while later the sea prevented occupation and biological intrusions (tree roots, rodents etc.). In recent years the submerged Neolithic settlements were exposed due to human activity in the coastal zone, mainly sand quarrying and construction of marine structures, together with seasonal sea storms that have removed the covering sand layer and exposed sections of the sites (Wreschner 1977a, b; Galili – Weinstein-Evron 1985; Galili et al. 1988). Shortly after exposure, the sites and their contents undergo erosion and begin to disintegrate.

Until recently, data on Levantine coastal Neolithic communities was relatively scarce and their role in the Neolithic revolution was barely understood (Galili 2004). The unique physical conditions and circumstances of their preservation and exposure, together with intensive underwater rescue surveys and excavations over the past four decades, have yielded a jigsaw puzzle-like array of randomly uncovered portions of the sites. Collating the accumulated data has facilitated identification of occupation patterns, the surrounding environment, and the material culture of the inhabitants. This has enabled us, for the first time, to draw a comprehensive picture of the material culture, economy, and socio-cultural practices of coastal communities in the southern Levant during two critical transitional periods: the Late Pre-Pottery Neolithic C (PPNC) c. 9250-8000 cal. BP and the Late Pottery Neolithic (PN, Wadi Rabah Culture = WR)<sup>1</sup> c. 8000-6500 cal. BP (Fig. 2). Additionally, they have permitted reconstruction of the palaeo-environment and its impact on coastal populations during this important period in human prehistory. The submerged sites are described and discussed below as are the main subsistence and material culture changes that occurred at the transition from the PPNC to the later WR PN.

Prehistoric cultures South Levant	C 14 Carmel coast sites	Prehistoric cultures - submerged settlements Carmel coast	Years BP calibrated
Pre Pottery Neolithic B			9500
Pre Pottery Neolithic C		Pre pottery Neolithic C Atlit-Yam site	9000
Pottery Yarmukian culture			8000
Late Pottery Neolithic/Early Chalcolithic, Wadi Rabah culture		Late Pottery Neolithic Wadi Rabah Sites	7000
Chalcolithic			6000

Fig. 2: Cultures of the 7<sup>th</sup>-10<sup>th</sup> millennia BP in the Levant.

## 2. Field methods

Studying the submerged prehistoric sites underwater, occasionally in shallow, highly energetic marine environments, raised methodological and logistical problems requiring the development of novel survey and excavation methods (Galili et al. 1993; Galili 2004). However, these sites offered unusual opportunities since natural forces exposed extensive areas of the inhabited sites and their environment. Excavations and surveys have been carried out since 1985 on behalf of the Israel Antiquities Authority and University of Haifa, headed by E. Galili, using scuba-gear, dredging system operated with water pumps, as well as measuring and photographic equipment. The upper layer of loose sand that covered the finds was removed manually

or by a dredging system. Archaeological features were excavated manually by spatula using a grid system with squares of 1×1 m and subdivision of 0.5×0.5 m, separating strata every 10 cm. The excavated soil and material was removed and taken ashore in plastic bags for wet and dry sieving. Human skeletons were excavated manually by spatula. After exposure, the skeletons were measured, drawn and photographed. The bones were then taken ashore and underwent a series of conservation treatments, including soaking and repeated washing in fresh-water tanks to dissolve the salts. Animal remains were treated in the same fashion. *In situ*, undisturbed sediment cores were taken from key areas and structures for pollen and sediment analysis.

3. The submerged Pre-Neolithic sites

Scattered traces of flint implements and few animal bones embedded in paleosoil (clay or Hamra red soil) were recovered at the submerged sites of Caesarea, Kfar Samir and Nahal Beit Haemeq off Shave-Zion (Fig. 1a). These provide the only underwater evidence of human presence prior to Neolithic times. All three sites represent cultural traces of a more ephemeral nature and density than the 6 *in situ* Neolithic villages. The submerged prehistoric sites are described below in chronological order with the oldest ones first, and each group is arranged in geographical order from north to south (Fig. 1a-b).

3.1 Middle Paleolithic

3.1.1 Kfar Samir centre is located on the southern municipal beach of Haifa city (Fig. 1b). Scattered

flint implements, some produced using Levallois technique, were recovered in association with a large Neolithic settlement (Galili – Weinstein-Evron 1985 and see below ‘Kfar Samir centre’). Many of these tools are double patinated indicating possible re-use by the Neolithic inhabitants.

3.2 Epipaleolithic

3.2.1 Nahal Beit Haemeq inlet (northern Israel) is located between the towns of Shave-Zion and Nahariya, at a water depth of 5-7 m some 150-250 m offshore (Fig. 1a). The site was embedded in a fossil paleosoil exposed on the sea bottom. Skull remains of a big herbivore (probably wild cattle) were discovered in the clay (Galili – Inbar 1987; L.K. Horwitz pers. comm. 1991). Several non-diagnostic flint artifacts were recovered near the skull. Thus the site may be Pre-Neolithic or Neolithic in age.

3.2.2 Caesarea south anchorage (central Israel) is located at the southeast corner of the Caesarea South anchorage at 1-2 m depth, some 20-50 m offshore (Fig. 1a). The remains are embedded in a brown sandy clay, locally termed ‘Hamra’ that was exposed on the sea bottom after a storm. The finds consist of 12 flint implements, including 6 microlithic blades, a few flakes and core fragments (Galili – Inbar 1987).

4. The submerged Neolithic sites

4.1 Atlit-Yam PPNC is the major submerged site discovered and studied since the 1980s. It is located 300-500 m offshore, at 8-12 m below sea level in the North Bay of Atlit, 10 km south of the city of Haifa (Fig. 1b). The site is periodically exposed by waves and sea currents. Some 30,000 m<sup>2</sup> have been studied i.e. almost 70% of the esti-

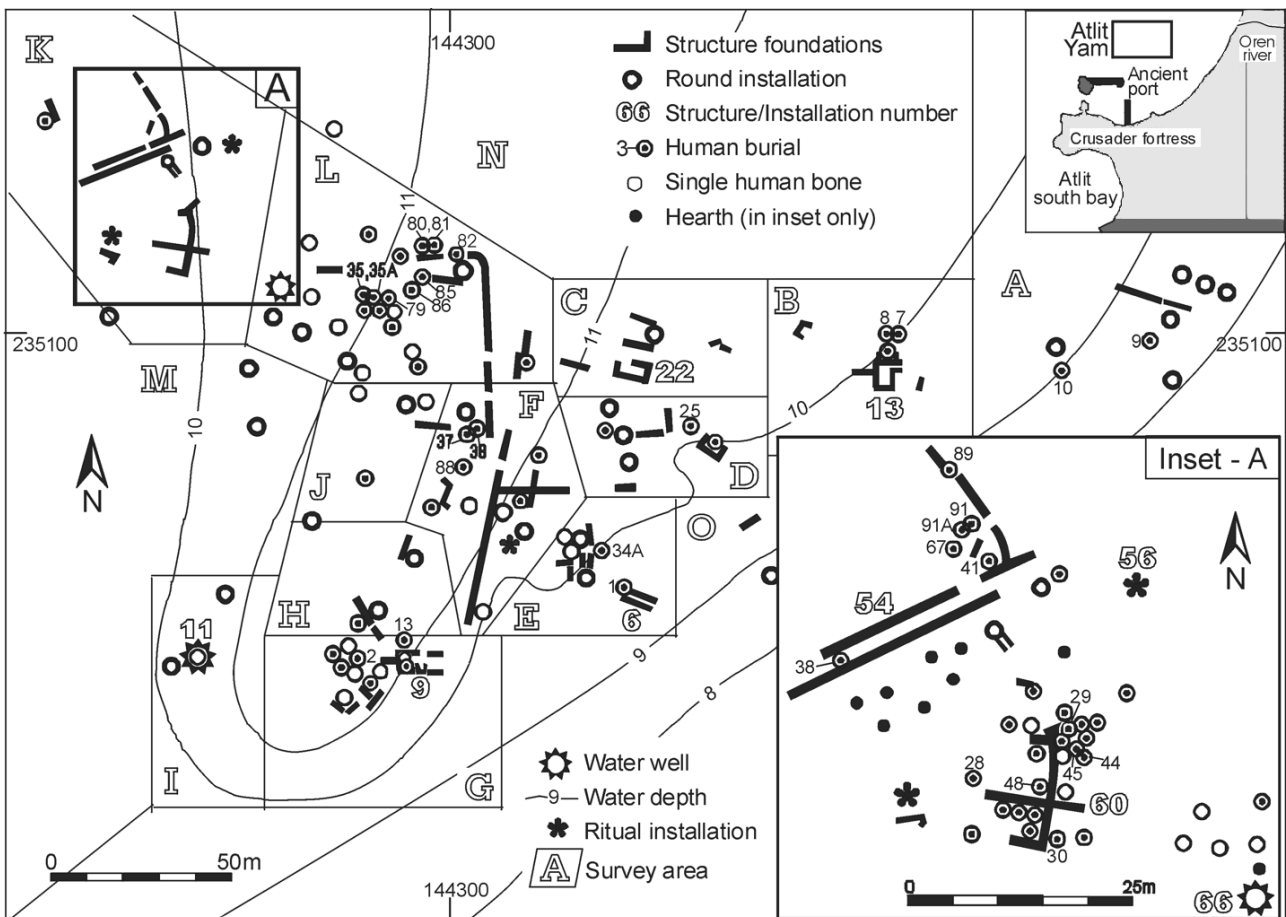


Fig. 3: Plan of the Atlit-Yam site.



Fig. 4: Megalithic structure No 56 composed of standing stones arranged in semi-circle.

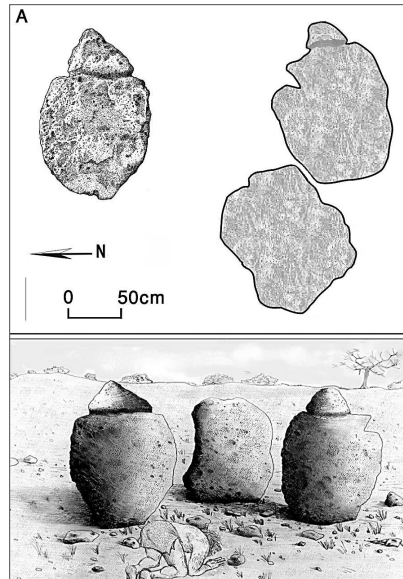


Fig. 5: Megalithic structure No 67 with stones depicting anthropomorphic image.



Fig. 6: Well no. 11. Left: opening, right: looking up from bottom

mated total area of this site (Fig. 3) and so offers a unique opportunity to examine a large settlement and its surrounding terrain.

Radiocarbon dates on charcoal and waterlogged plant remains range from c. 9250-7970 cal. BP and place the site in the PPNC, i.e. at the end of the Pre-Pottery Neolithic (PPN) period (Fig. 2). Excavations revealed structures, installations, and rich assemblages of implements made of flint, stone, bone and wood, human burials as well as faunal and floral remains. The village economy was complex, based on hunting, herding, fishing and farming (Galili et al. 2002; Horwitz et al. 2002; 2006; Galili et al. 1993; 2004; Galili 2004). It is the largest and best preserved submerged PPNC site and the only known coastal site

of this period with water wells, dwellings and *in situ* human remains (Galili et al. 1993; Hershkovitz – Galili 1990; Galili et al. 2005; Eshed et al. 2004a; Eshed – Galili 2011).

- **Architectural remains** comprise wall foundations of several rectangular structures (dwellings), long straight walls of up to 30 m long, a wall built of mud bricks, pairs of parallel walls, paved floors, water wells (details below), hearths as well as about 20 round storage and production installations made of undressed stones. Two megalithic ritual structures were also found; Megalithic Structure no. 56 consists of seven large stones, six of which are still standing upright forming a semicircular feature (Fig. 4)

while Megalithic Structure no. 67 consists of three oval stones, two of which are circumscribed by grooves forming schematic anthropomorphic figures (Fig. 5) (Galili et al. 1988, 1993). The structures and installations are scattered sparsely over the site separated by wide-open spaces (Fig. 3), a settlement pattern which is characteristic of a village. The long walls discovered at the site may have defined family or group 'territories', and may indicate that these groups functioned as independent production units. For example, cereals and legumes may have been cultivated in the open spaces within the site or else animals, such as pigs, caprines or cattle, were kept there. As such, the site may represent a cluster of family units with each unit consisting of dwellings, courtyards and open spaces in which production, storage and various other activities took place.

- **Water wells and pits.** At Atlit-Yam, about thirty round stone features, with a diameter range between 0.8 and 1.5 m, were found, some representing water wells (Fig. 3) while others are storage pits. Well no. 11 was excavated down to its bottom. The other well (no. 66) was partly excavated to a depth of about 1 m. The well and pit fills were excavated manually using the dredging system and their contents underwent a series of wet and dry sieving routines (Galili – Nir 1993; Galili 2004; Galili – Rosen 2011a, 2011b). One of the stone-built pits was excavated to its bottom (1 m below site surface) and contained masses of waterlogged plant material: straw identified as fodder.

Well no. 11 was cylindrical, 5.5 m deep and 1.5 m in diameter (Fig. 6). Its upper section was built of undressed stones. Three courses had survived *in situ* above the present seafloor forming a wall (0.7 m high) circling the open shaft, thus preventing the introduction of foreign objects. The uppermost 3.6 m of the well were dug into clay sediments and surrounded by 22-25 courses of stone. The number of stones in each course varied between 14 and 24. The lower section,

3.60 m to 5.15 m below the site surface, was quarried into carbonate-cemented quartz sandstone ('kurkar'). The well fill presents a complex multi-layered deposit, which can be divided into three main sedimentation phases. **Phase 1:** The upper phase was composed of small and medium (3-15 cm) undressed kurkar stones and broken limestone pebbles, most showing signs of exposure to extreme heat. This phase also contained carbonate sand composed of crushed shells and whole mollusk valves (*Glycymeris* sp.) – all probably late intrusions. **Phase 2:** The middle phase extended from just below the previous land surface; down to 2.10 m. Materials found in this phase were typical of human habitation refuse. It contained numerous animal bones, undoubtedly representing discarded consumption debris deposited when the well was no longer used, waterlogged and charred plant remains, and hundreds of flint, stone, wood and bone artifacts and waste from flint working. The fill was composed mainly of soft clay, small and medium-sized stones, with some quartz and carbonate sand present. Lenses of very fine, soft clay were attached to the walls. There were two clear layers of medium to large (15-30 cm long) stones embedded at 90-110 cm and 180-200 cm respectively below the former land surface. Traces of gypsum, found ca. 80 cm below site surface, testified to high-salinity conditions. Around 180-210 cm below the site surface, numerous land snails were found. **Phase 3:** The lower phase, 200-500 cm below surface, contained kurkar stones of various sizes embedded in sandy clay, various flint, bone and stone artifacts, a few animal bones and sediments typical of coastal water wells (Galili – Nir 1993; Galili – Rosen 2011a; Nir – Eldar-Nir 1986, 1987, 1988). Three  $^{14}\text{C}$  dates on wood (Table 1) from this lowest section, have a  $2\sigma$  calibrated age range of 8380-8190 cal. BP after averaging (Galili 2004; E. Boaretto, pers. comm. 2005). Relative to the central phase, the lowest phase of the well contained more plant materi-

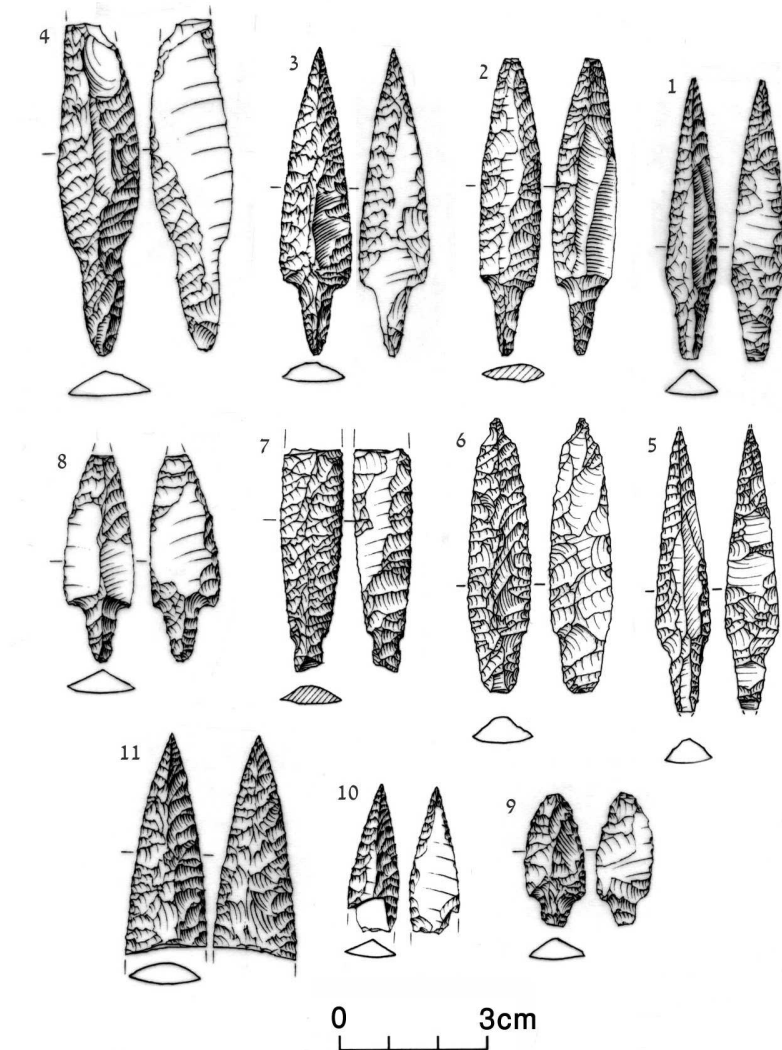


Fig. 7: Arrow heads from Atlit-Yam.

al. Faunal remains from the entire well fill included some hundreds of bones of herbivores, carnivores, rodents, reptiles and fish. A few human bones were also found. The artifacts made of flint, stone, bone and wood recovered from the well were mostly broken. It is likely that this well ceased to be productive because of seawater seepage due to continuous sea-level rise (Galili et al. 1993; Galili – Nir 1993). The presence of gypsum, indicative of high salinity, supports this proposition. The layers of large stones may be seen as attempts at heightening the bottom of the well for the purpose of obtaining water from higher aquifer levels. The re-use of excavated shafts and abandoned wells for refuse disposal is documented at other prehistoric sites, including Mylouthkia on Cyprus

(Peltenburg et al. 2001), Sha'ar Hagolan in Israel (Garfinkel et al. 2005), and several sites in Europe (e.g. Weiner 1998).

**Well no. 66 (Fig. 3)** was excavated down to one m below the surface and the bottom was not reached. The shaft was dug into the clay and was walled with undressed stones. One course of undressed stones survived above the surface. This circular feature was 110 cm in diameter and the fill contained soft clay with hundreds of small and medium-sized stones. Faunal remains included numerous bones of herbivores, carnivores, rodents, reptiles and fish, similar to well no. 11. Artifacts made of flint, stone and bone were also recovered, most of them broken. Two  $^{14}\text{C}$  dates on wood from this lowest section, have a  $2\sigma$  calibrated age range of



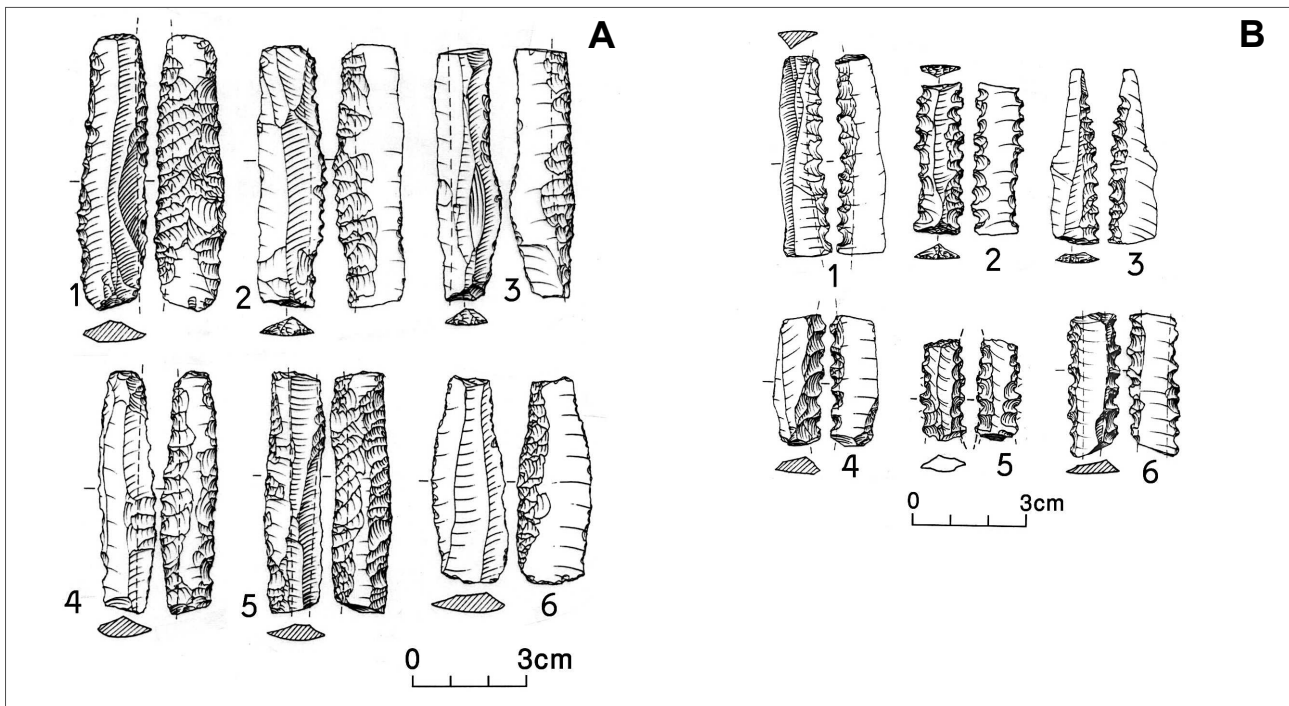


Fig. 8: Sickle blades: A) typical PPN elongated blades with fine retouch, B) denticulated sickle blades.

8720–8450 cal. BP after averaging (Galili 2004; E. Boaretto, pers. comm. 2005).

- **Botanical remains.** The rich, well-preserved finds of Atlit-Yam include seeds and other organic remains of 91 plant species as well as tree branches and pollen grains (Galili et al. 1993; Kislev et al. 2004). Seeds of domesticated plants include wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), lentils (*Lens lentis*) and flax (*Linum usitatissimum*). Flax fibers recovered from the site and the flax seeds may indicate that this plant was used for the manufacture of fishing nets or lines. Seeds of fruit species, which most probably had been collected from the wild, include almond (*Amygdalus communis*), fig (*Ficus carica*), grapes (*Vitis silvestris*), date (*Phoenix theophrastii*). Additionally various seeds of plants commonly used for fodder (Galili 2004, 240) were recovered and identified. Obligatory weeds identified within the plant remains suggest that domesticated cereals and pulses were cultivated and grown in fields by the inhabitants (Hartman et al. in press).
- **Faunal remains.** A large and well preserved assemblage (over 8,000 bones) was recovered

from various localities in the site of Atlit-Yam. They demonstrate that hunting, herding and fishing were all practiced (Horwitz – Ducos 2005; Galili et al. 1993, 2002, 2004; Zohar et al. 1994, 2001). The main mammalian species identified are domestic caprines – goats (*Capra hircus*) and sheep (*Ovis aries*) –, cattle (*Bos taurus*), domestic pigs (*Sus scrofa f. dom.*) and dogs (*Canis familiaris*). Remains of some of the cattle and goats resemble their ancestral wild forms and probably represent primitive domesticates i.e. animals in the early stages of domestication. Wild species include wild boar (*Sus scrofa f. fer.*) mountain gazelle (*Gazella gazella*), Persian fallow deer (*Dama mesopotamica*), carnivores especially red fox (*Vulpes vulpes*), a range of reptile, rodent and amphibian species as well as insects (granary weevil, *Sitophilus granarius*). Faunal remains from the surface collection indicate that in the early phases of the settlement, wild animals and those in the initial stages of domestication were dominant, especially remains of adult cattle. In contrast, in the fill of the well, representing a slightly later occupation stage, remains of juvenile animals were predominant,

especially those of domestic goats, sheep, pigs and dogs. In both assemblages, butchery damage was evident on numerous bones in the form of cut and chop marks (Greenfield et al. 2013), but few of the bones were burnt. More than 6000 fish remains (bones, scales, teeth) were recovered from the site. Taxonomic status was determined for 94% of the recovered bones. Seven families of Mediterranean marine fish were identified, representing a minimum number of 109 individual fish. Of all identified remains, 97% were of the Grey trigger-fish (*Balistes carolinensis*) suggesting that this fish was abundant in the region during the occupation (Zohar et al. 1994, 2001). Of the recovered fish bones, 6% were blackened by fire, indicating direct association with human processing activities. Similarly, many of the fish remains were found in concentrations and in close association with archaeological remains, indicating that they were *in situ* and do not represent more recent intrusions.

- **Flint industry.** The distribution pattern of flint assemblages indicates that at least three different activities took place at the site. The assemblage from

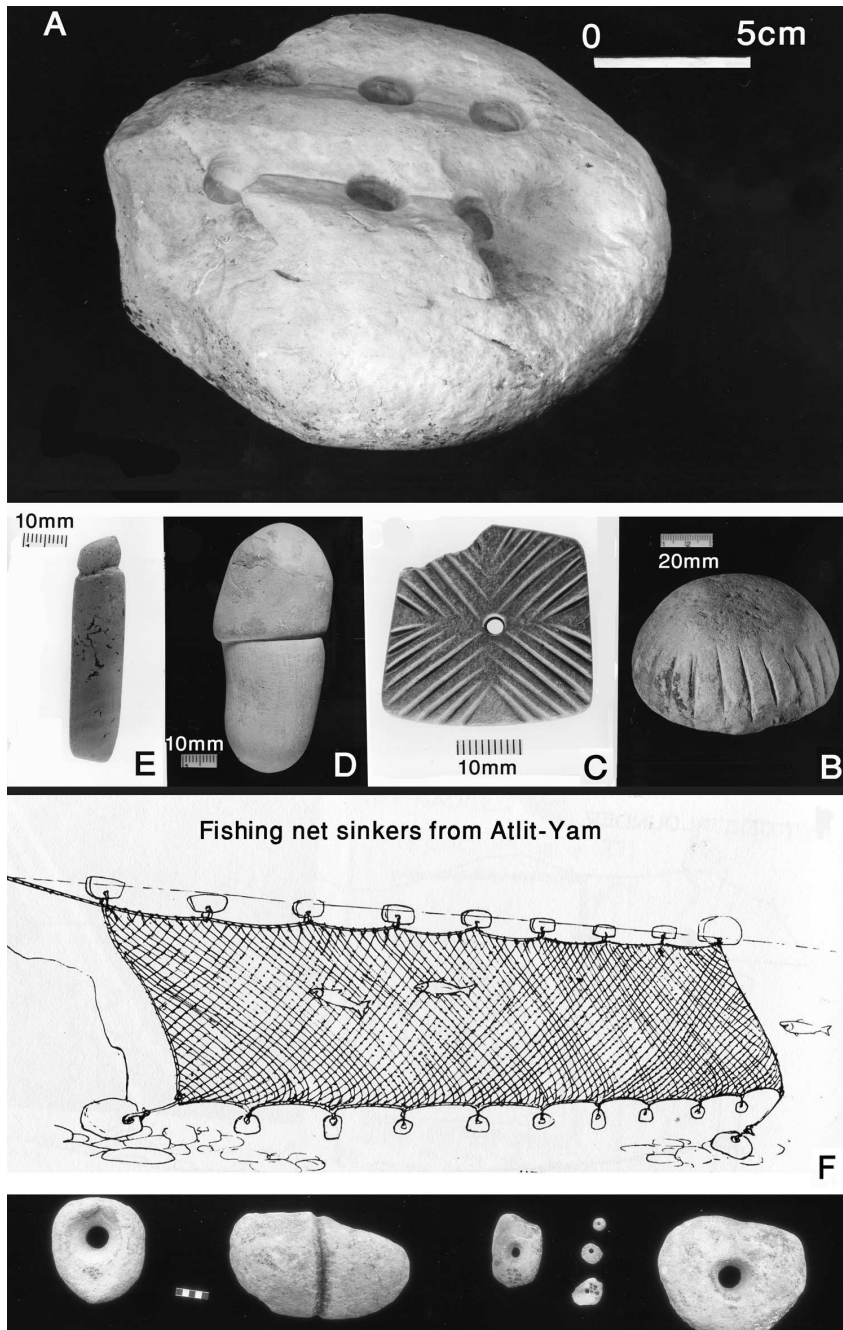


Fig. 9: Ground tools from Atlit Yam: a) game board, b) decorated anvil, c) decorated button, d-e) phallic items, f) fishing net sinkers.

Locus 35/A represents a chipping floor or a workshop with a high percentage of the cores having two striking platforms, indicating specialized blade production. Tools such as arrowheads (Fig. 7) and axes were also produced here, hafted and repaired. The lithics from the surface assemblage of the site had a relatively high percentage of bifacial tools, indicating that there was intense processing of wood in the site, which may be associated with watercraft production (Barkai and Galili 2004;

Yerkes et al. 2014). Elongated sickle blades with fine retouch as well as denticulated blades (Fig. 8) attest to cereal cultivation and harvesting. Some of the sickle blades bear traces of bitumen originated from the Dead Sea. The material recovered from well 11 contains mainly flint industry waste which was deliberately dumped into the well, especially in the upper part. Flint cores in Atlit-Yam follow the general frequencies found in other PPNC sites in the southern Levant, with a large quantity of naviform cores.

- The ground stone assemblage of Atlit-Yam includes mainly containers such as large basins made of kurkar (sandstone) and limestone, polished bowls and cup marks. Polished pebbles, hammer stones, perforated stones, grinding slabs and a game board (Fig. 9a) were also recovered. Ornamental stone artifacts include: an anthropomorphic figurine depicting a female buttocks, a phallus, decorated pendants, pendants, decorated discs and rings and a decorated anvil (Fig. 9b-e).
- Human remains. The 65 human individuals recovered from Atlit-Yam constitutes almost half of all known PPNC burials in the Levant. Of the 65 individuals, 61 were uncovered in graves (primary, secondary or disturbed). Two additional individuals added to the count relate to bones that were found scattered in the site (mainly bones that had been shifted from their original burial by sea currents and post-depositional processes) (Galili et al. 2005; Eshed – Galili 2011). Burials were mostly (37 cases) primary (Fig. 10a-b), although evidence of 6 secondary burials were found (Fig. 11). Group burials, mainly containing two individuals (11 cases) and three individuals (2 cases) comprise one third of all primary burials. Most of the deceased were found in flexed or semi-flexed positions with no clear pattern in orientation. Skulls were usually intact, but there are occurrences of skeletons with no skull and a single separated skull burial. Graves were usually simple, with little investment. The dead were interred in pits dug in the clay, sometimes with a few stones on top or around the grave. Some of the skeletons were scattered over various parts of the site, around structures but rarely within structures. However 45 burials were concentrated in the northwest section of the site (areas K and L, Fig. 3). Twenty three of these were adjacent to a single rectangular dwelling structure (no. 60) and were associated with hearths and a megalith (Hershkovitz – Galili 1990; Eshed 2001; Galili 2004;





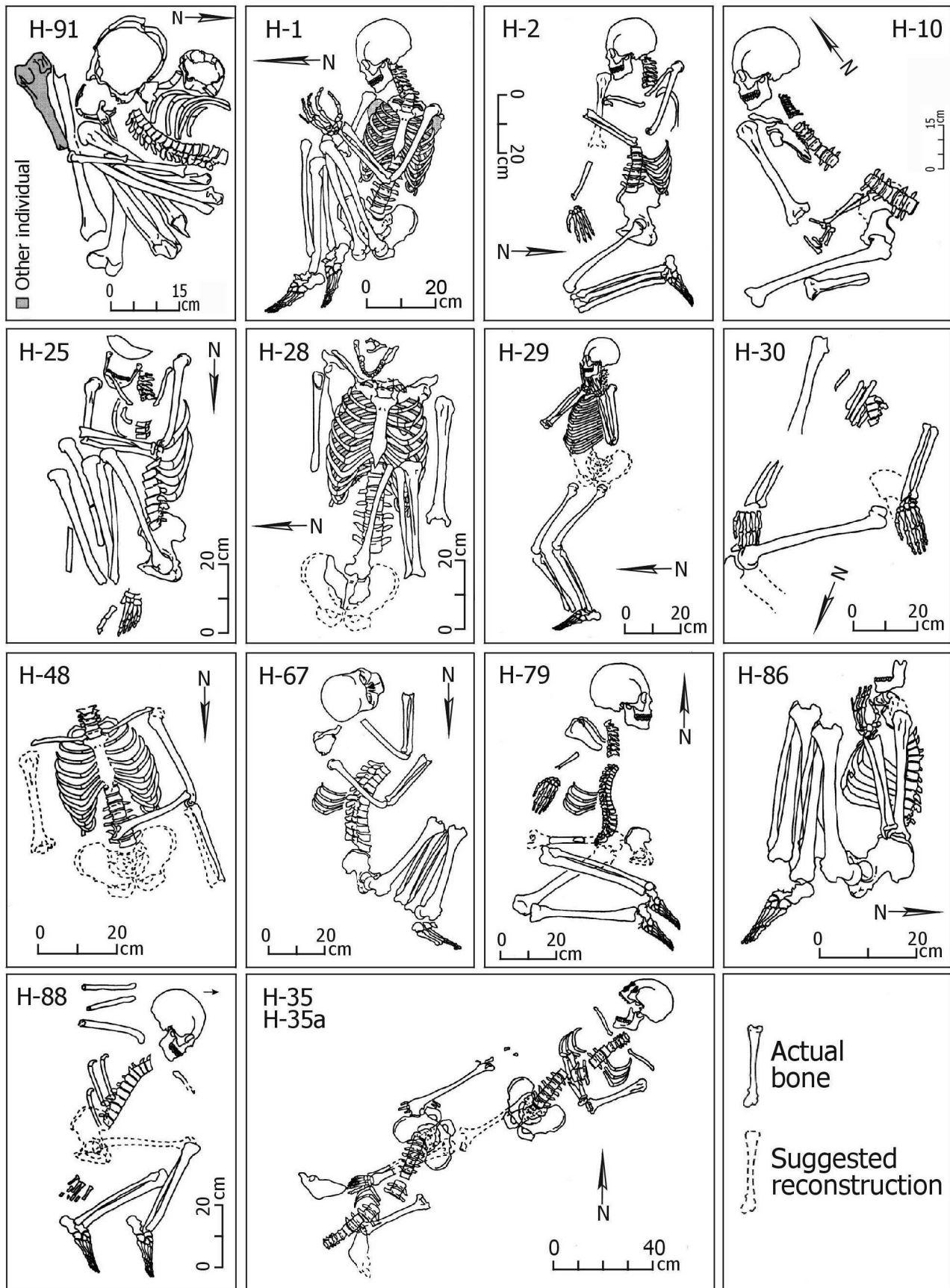


Fig. 10: a) Adult skeletal remains from Atlit-Yam.

Galili et al. 2005). Numerous skeletal pathologies were identified in the Atlit-Yam popula-

tion. They included an ear pathology, auditory exostosis, evident in the male population that is

caused by frequent diving in cold water, perhaps indicating an engagement in underwater



Fig 10 b) Burial of a woman in flexed position.

spear-fishing (Hershkovitz – Galili 1990). The presence of *Thalassemia* identified in some skeletal remains suggests that the Atlit-Yam population may have developed immunity to malaria, a disease that was common in the swampy coastal plain of the southern Levant (Hershkovitz et al. 1991; Eshed et al. 2010). An adult female buried together with an infant exhibited skeletal pathologies suggestive of tuberculosis (Hershkovitz – Galili 1990; Galili et al. 2005), a finding that was confirmed by aDNA analysis (Hershkovitz et al. 2008; Donoghue et al. 2009). It is believed that this is the earliest confirmed report of tuberculosis in humans. At Atlit-Yam cattle bones are common in the zooarchaeological assemblage indicating their importance as a major dietary component. However, aDNA testing of these remains for *Mycobacterium bovis* (the bacteria causing cattle tuberculosis) has been negative and may support the theory that the disease spread because of human population density, rather than due to close contact with domestic cattle.

- **Grave offerings** were modest, and were found next to, or underneath, the skeletons. They occur in a considerable number of graves; 21 artifacts were associated with 15 of 46 graves (32%). The offerings comprised 5 flint axes, 5 ground stone tools, 1 calcite crystal, 2 bone artifacts, 5 flint artifacts and 2 cattle horncores. The grave goods seem to have been gender-oriented, e.g. some males were buried with stone axes (Barkai – Galili 2004) while a grinding stone was found in a female grave.

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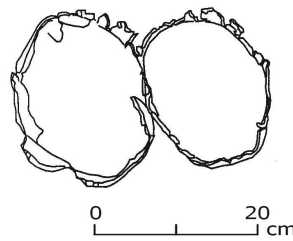


Fig. 11: Secondary burial of pair of children.

#### 4.2 Pottery Neolithic settlements

Six submerged settlements belonging to the WR culture were discovered in a 15 km long and 200 m wide coastal belt: Kfar-Samir (north, center and south), Kfar-Galim (north, south), Hahotrim (north and south), Nahal Galim, Tel Hreiz, Megadim and Neve-Yam (north and south) (Fig. 1b). These 8<sup>th</sup> millennium cal. BP sites are located close to the present coastline at a depth of 0-5 m below sea level (Wreschner 1977a, b; Ronen – Olami 1978; Galili – Inbar 1987; Galili – Weinstein-Evron 1985; Galili – Sharvit 1994-5; Galili et al. 1988, 1989, 1997, 1998, 2002; Galili – Schick 1990; Galili – Rosen 2007, 2013). Most of the archaeological material was collected in the course of underwater surveys and sometimes on the coast after storms. A few limited excavations were carried out in Kfar Samir central sector (water wells and installation for the extraction of olive oil), Kfar Galim (a pit walled with stones), Megadim (a pit walled with stones) and Neve Yam (stone built graves).

**4.2.1 Kfar Samir** site lies at a depth of 1-5 m, some 10-200 m offshore (Fig. 1b). The prehistoric remains are scattered along a 1200 m elongated strip on the sea bottom, parallel to the coastline. The site

may be divided into northern, central and southern sections. The <sup>14</sup>C dates, potsherds and the lithic typology place the site in the late ceramic Neolithic period i.e. the WR culture.

**4.2.1.1 Kfar Samir northern sector** is located at the north section of the Kfar Samir site (Fig. 1b). Four vertical stone slabs (1.3×0.9×0.5 m) and some tilted slabs (at ca. 45 degree angle) were recovered at a water depth of 1.5-2.5 m, some 30-60 m offshore. One end of the slabs was partly inserted in the clayey bottom and they may represent symbolic or ritual features or mark burials or locations of importance.

**4.2.1.2 Kfar Samir central sector** is located 1-200 m from the water line, at a depth of 0-5.5 m (Fig. 1b).

- **Architectural remains.** Architectural remains here included floors made of un-worked and uneroded local stones, 8-10 cm in diameter, partially embedded in the clay, and additional floors constructed of flat stone slabs. A few hearths, ca. 0.5 m in diameter, were located. In one of them the bottom of the hearth was lined with stones and contained fragments of burnt bones and charcoal. Several dozen meters to the south of this hearth, an installation for producing olive oil was exposed. It comprised a pit containing crushed olive pits, evidently olive oil extraction waste (Galili et al. 1997, 1989; Galili – Sharvit 1994-95; Galili – Rosen 2007). The <sup>14</sup>C dates of the olive pits range from 7480-7230 to 6669-6519 cal BP. These dates attribute the finds to the PN WR culture.
- **Three water wells** were identified in the north-west edge of the site submerged at a depth of 5 m, some 200 m offshore. They were constructed of alternating courses of wooden branches and undressed stones (mostly limestone pebbles). The southern well (No. 3) had a rectangular opening 1×0.8 m. It was excavated to a depth of 2 m, but the bottom was not reached. This well is built of alternating courses of wooden branches





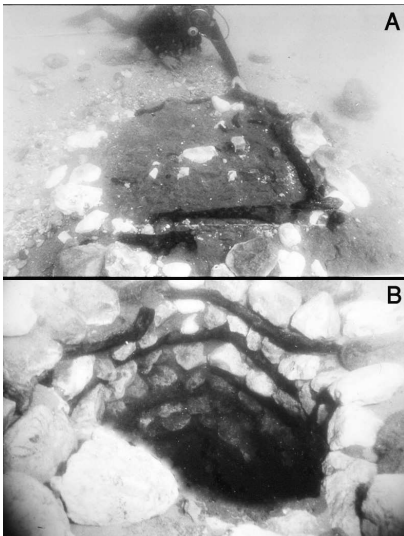


Fig. 12: Water-well 3 constructed of alternating courses of wooden branches and stones: A) before excavation, B) after excavation.

and pebbles (Fig. 12). With depth it widens and becomes more circular in plan. In its lower part, two courses of stones were laid between the beams. The well fill consisted of small pieces of stone and clay as well as several bird bones, olive pits, some pot sherds (one with an incised design), flint flakes and probable straw remains. Wood samples from the well were  $^{14}\text{C}$  dated and the ages range between 7890-7615 to 7005-6385 cal BP.

- **Flint implements.** It is possible to identify two different groups of lithic implements. The first consists of tools which represent the period of site occupation (axe, burin). The second group consists of Levallois implements which clearly show secondary use of older implements as indicated by double patination. These may be attributed to the Middle Paleolithic. This suggests that the older, Middle Paleolithic implements were curated to the site at the time of the Late Neolithic occupation.
- **Wooden container.** During the winter of 1991, a paved section made up of small unworked stones (5-7 cm) placed closely together, was exposed on the clay seabed of the Kfar Samir site, at a depth of 0.5 m and 15 m from the shoreline. On this pavement, a fragment of a pot-

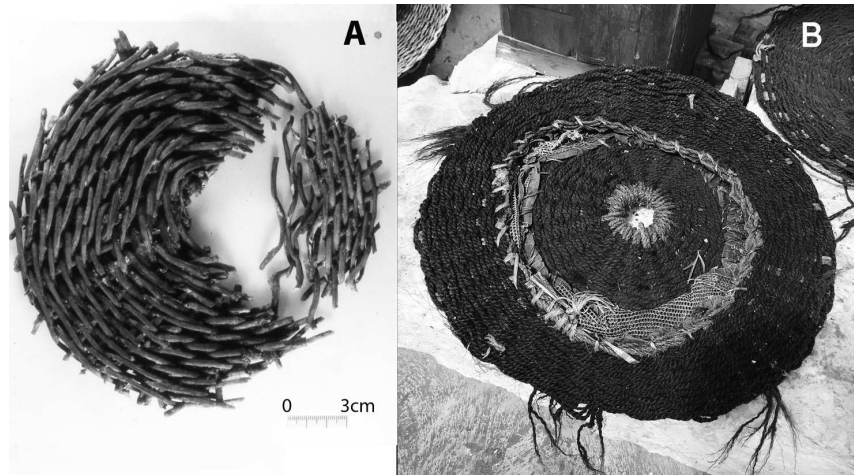


Fig. 13: A) Basketry item made of woven twigs, probably used as strainer for olive oil extraction, B) modern strainer.

shaped wooden bowl survived. It included a part of the flat base, a straight wall that is slightly inverted and a section of the rim. An elongated knob handle on the upper part of the wall was perpendicular to the rim and has a narrow lateral perforation.

- **Basketry.** During the winter of 1994, a pit (diameter 0.9 m, depth 0.55 m) dug into the clay seabed was exposed at a depth of 2.3 m. Excavation of the pit uncovered water-logged pieces of a braided basketry vessel embedded in soft gray clay (Fig. 13), tree branches and dozens of olive pits. Three braided pieces made of thin branches (diameters 3-5 mm.), were probably parts of the vessel that fell apart. One of the braided pieces was round and may have formed the vessel's base; the other two probably come from its walls. The braiding used the method of alternate pair twining. The warps emerge from the center of the base, perpendicular to its rim and parallel to each other. The wefts are alternately twined around two warps and cross over after each pass. In several places the wefts are twined around three warps or only around a single warp. Usually the warps are made of one branch; however, in a few places they consist of a pair of thin branches next to each other. It seems that the braiding represented remains of a receptacle (basket) used for pressing olives for their oil (locally termed aqal) (Fig 13b). The braiding was

dated by  $^{14}\text{C}$  to 7517-7038 cal BP. During the 1984 survey, a second unique basketry item was found at a depth of 1.5 m in an unlined pit dug in the upper clay level. After laboratory treatment it turned out to be a mat 70×160 mm in dimension. It is made of bundles of unidentified material, perhaps rushes or straw. From the technological point of view it may be assigned to a technological type "coiled basketry with intricate stitch (Galili-Rosen 2007)".

- **Faunal remains.** In the central sector of Kfar Samir faunal remains were scarce. A few bird bones were recovered from the well and included seven bones of mallard duck *Anas platyrhynchos* and one unidentified mammalian bone fragment (Galili – Weinstein-Evron 1985:40; Horwitz et al. 2002).

4.2.1.3 Kfar Samir southern sector is located in the southernmost part of Kfar Shamir site (Fig. 1b).

- **Architecture.** During the 2012 surveys, an elliptical building, constructed from upright stone slabs, was exposed near the shore at the southernmost part of the Kfar Samir site (Fig. 14). Hundreds of olive pits were discovered in the vicinity of the building (Galili – Rosen 2013).
- **Wooden container.** During the 1989 surveys a complete bowl (Fig. 15) was found c. 300 m south of the Kfar Samir central sector (Galili – Schick 1990). The bowl was made of Cera-



Fig. 14: Elliptical structure constructed from upright stone slabs.



Fig. 15: A complete bowl made of carob tree.

*tonia siliqua*, carob tree or St John's-bread. It was found in a pit in the clay. Pieces of unidentified branches or straw, perhaps remains of a mat or a basket, were found next to it. Marks of the tool used in forming the outer face, perhaps an adze or a chisel, were discerned as well as traces of an imperfection left by a fracture in the tool used to form the bowl. The inner surface of the bowl was made using a different tool and it looks less finished compared to the outer surface – perhaps because of objective difficulties in forming such a surface using a chisel-like tool. The base and the rim of the bowl were very smooth, either polished intentionally by some abrasive or abraded by lengthy use. The bowl was dated by  $^{14}\text{C}$  to 8115-7949 cal BP.

**4.3 Kfar Galim north** is located some 50-120 m off the coast at a depth of 1/5-4 (Fig. 1b). Surveys carried out at the site revealed several round structures (1-1.5 m in diameter) made of undressed stones, representing either refuse pits or water wells. Other structures discovered were pits built of water-logged tree branches and



Fig. 16: A water-well built of tree branches and stones – Kfar Galim site.



Fig. 17: A water-well constructed of undressed stones.

stone pebbles (probably water wells). A cylindrical “tower” (1.2 m. high) consisting of six courses of undressed stones was found above one of the round stone structures. A test excavation carried out in one of these stone-built structures yielded a few potsherds and flint flakes and fragments of plant material. Finds recovered from the site as a whole include an abundance of ground stone artifacts of limestone, sandstone and basalt (mortars, grinding stones, chalices on high cylindrical bases made of basalt, troughs or mangers, cup marks), as well as a few potsherds and animal bones. The faunal remains comprise an adult male mountain gazelle horncore (*Gazella gazella*) and a mandible of a rodent identified as Palestine molerat (*Spalax ehrenbergi*) (Horwitz et al. 2002). Flint artifacts include a few flake tools and four bifacials (adzes and axe). A single  $^{14}\text{C}$  date (7790-7670 cal BP) taken from a wooden branch, places this site well within the range of the Late PN period.

**4.4 Kfar Galim south** is located south of Kfar Galim (Fig. 1b), some 30-100 m offshore, at a depth of ca. 2-4 m.

- **Architecture.** Several rows of undressed stones, some forming right angles, imply the existence of rectangular structures, probably dwellings. Other architectural remains were six round, stone-built pits as well as stone and wood structures, probably water wells. Test excavations in two of these structures revealed fills of sherds, flint artifacts, water-logged plant remains and animal bones. During the 2012 surveys, four additional wells (diameters ca. 1 m) built of stones and tree trunks (trunk diameter 0.1-0.3 m; Fig. 16) were revealed at a depth of 1.5-3.0 m below sea-level. In one of these, three waterlogged tree trunks (25 cm long, 15 cm diameter) that had been cut in both ends were located. Their dimensions and shape suggest that they were pre-forms intended for the production of wooden bowls as found at Kfar Samir center and south. Radiocarbon dates of wooden branches from the site (6910-6670 cal BP) date to it to the PN period.
- **Artifacts.** Pottery finds include 15 fragments of bases and handles all typical of the WR culture, as well as few non-diagnostic body sherds. Flint implements include a few undiagnostic flakes.
- **Faunal remains.** Of the 58 animal remains recovered from this site, seven species were identified. Over 50% of the identified bones were those of domestic pig (*Sus scrofa f. dom.*), mainly immature animals, while domestic cattle, *Bos taurus* (22%) were the next most common taxon exploited. All cattle remains derive from adult animals. Present in very low frequencies were remains of domestic sheep/goat (*Ovis aries/Capra hircus*), dog (*Canis familiaris*), bones of a grey heron (*Ardea cinerea*), and vertebrae of an unidentified species of snake (*Ophidia*). There were also two fish bones belonging to the family *Sparidae* (sea breams) (Horwitz et al. 2002).



**4.5 Nahal Galim** is located opposite the outlet of the river Nahal Galim (Fig. 1b). Two round struc-

tures constructed of undressed stones (1-1.5 m in diameter), probably water wells, were discovered at 3-5 m depth. One of these structures, located some 150 m offshore at 4 m depth (Fig. 17) was marked by three rows of stones jutting out above the sea bottom (Galili – Rosen 2013).

**4.6 Hahoterim** is located west of Kibbutz Hahoterim (Fig. 1b). Several structures constructed of undressed stones (0.7-1 m in diameter), probably wells or storage pits, were identified at a water depth of 2-5 m. Hundreds of waterlogged olive pits and wooden branches were embedded in the clayey bottom of the site, indicating that olives were exploited, probably for oil extraction.

**4.7 Tel Hreiz** is located at a depth of 0-5 m, adjacent to the terrestrial Tel of the same name (Fig. 1b). The submerged site was first identified in the 1960s and initially identified as a Chalcolithic or Early Bronze Age site. Further surveys since 1984, as well as radiocarbon dates (8330-7970; 7210-6980 cal. BP), indicate that it represents a late PN settlement of the WR culture.

- **Architecture.** The 1965 survey revealed stone paving, hearths containing charred remains of wood and animal bones (including a jaw of Persian fallow deer, *Dama mesopotamica*), flint artifacts, potsherds and a basalt mortar. Likewise the 1984/5 and 1993 surveys noted the presence of stone structures and a row of poles made of waterlogged tree branches. During the 2012 surveys, a large section of the southern part of the site was exposed from the coastline to a depth of 4.5 m (Galili – Rosen 2013). A megalithic structure (length ca. 60 m) built of hundreds of boulders (max. length 1 m) was discovered at water depth of 3-4 m. Also several upright wooden columns (i.e. aligned at 90 degrees) were recorded. These may have been the foundations of a hut or a cabin. Other architectural finds include a square building (3×4 m) constructed

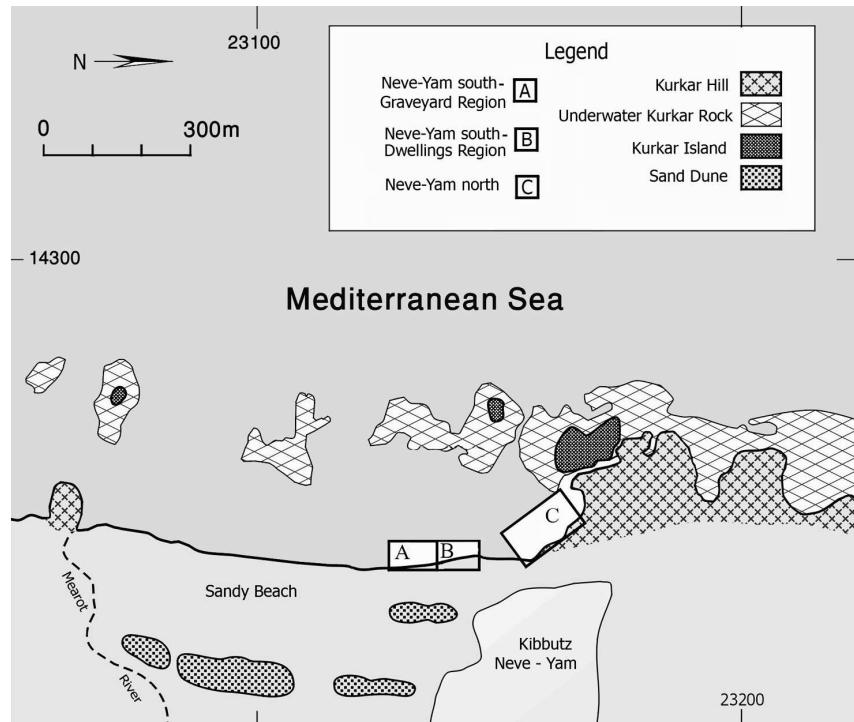


Fig. 18: Location map of: A-B) Neve-Yam south site, c) Neve-Yam north site.

of undressed fieldstones, a fireplace with charcoal remains and two round installations built of undressed stones.

- **Artifacts.** Flint artifacts include mainly bifacial axes and adzes as well as several sickle blades and additional blade tools, but no arrowheads. The pottery included numerous fragments of bowls and scores of handles typical of the WR culture. Ground stone remains included bowls, mortars and chalices made of basalt, sandstone (kurkar) and limestone.
- **Botanical remains** included hundreds of waterlogged olive pits, numerous tree branches and a circular ring woven of twigs. The olive remains indicate that olive oil extraction took place on-site.
- **Faunal remains** of eight animal species were identified, the majority representing domestic animals. Remains of cattle (*Bos taurus*) were the most common (53%) while sheep/goat (*Ovis aries/Capra hircus*) amounted to 16% and pigs (*Sus scrofa*) to 14%. Judging by their size most cattle were identified as domestic animals. The majority of pig bones came from immature individuals and included domestic pigs as well as wild

boars. Dogs comprised a significant proportion of the remains and represented 14% of the recovered animal bones. The several canine skulls belong to adult domestic dogs, similar to the ones identified at Kfar Galim. Wild animal species included Persian fallow deer (*Dama mesopotamica*), mountain gazelle (*Gazella gazella*) and two fish families – *Serranidae* and *Tilapia sp.*, a marine and freshwater species respectively (Horwitz et al. 2002).

- **Human remains** were scarce and consisted of a lower jaw and a few fragmented ribs.

**4.9 Megadim** is located north of Atlit some 80-120 m offshore (Fig. 1b), at a depth of 2.5-3.5 m (Galili – Weinstein-Evron 1985). Finds included three pits lined with undressed stones (possibly water wells) found some 50 m apart. The southern pit was partly excavated to a depth of 0.4 m. Finds included a few flint flakes, some waterlogged botanical remains (small tree branches and straw) and a canid mandible representing either a wolf (*Canis lupus*) or a dog (*C. familiaris*). The mandible was <sup>14</sup>C dated to 7310-7020 cal BP. Judging by the other canid remains found in the

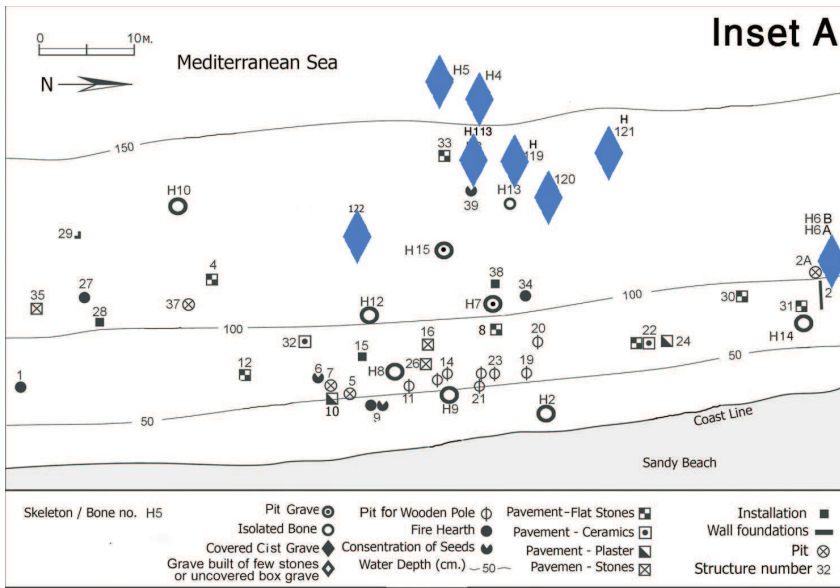


Fig. 19: Plan of the graveyard area in Neve-Yam south site.



Fig. 21: A pottery vessel with two openings.

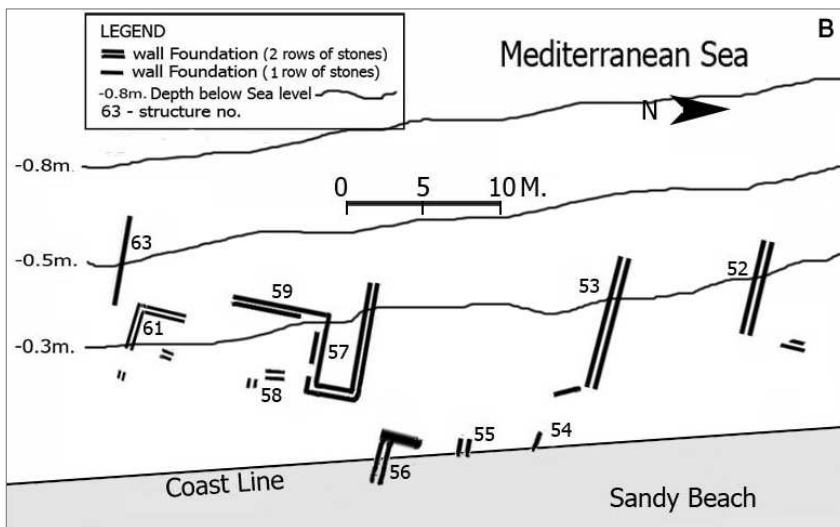


Fig. 20: Plan of Neve-Yam south site: the dwelling area.

contemporaneous sites of Kfar Galim and Tel Hreiz, it also probably belongs to a dog. Ground tools included three basalt chalices and two limestone bowls.

4.10 At Neve-Yam north (Fig. 18, C) the remains were few, but included pottery fragments (rims, handles and bases of bowls and containers) attributed to the Lodian culture. This culture was defined by Gopher – Gophna (1993) and predates the WR culture (Fig. 2).

4.11 Neve-Yam south site is located south of the sea front of Kibbutz Neve-Yam (Fig. 1b). It is the southern-

most submerged Neolithic site on the Carmel coast and is located between the coast line and a submerged Kurkar (aeolian sandstone) ridge at a water depth of 1-5 m. The site can be divided into two sections (Fig. 18, A-B): the southern section (Fig. 19) contained mainly graves, hearths, paved surfaces and small installations, and the northern section (Fig. 20) contained foundations of straight walls and rectangular structures (dwellings). The site was dated by three <sup>14</sup>C dates ranging from 7580-7270 cal BP (Table 1). According to the dates and the archaeological assemblages, both sections of the site are

attributed to the Late Neolithic WR culture/early Chalcolithic. A portion of the coastal section of Neve-Yam was first exposed during the late 1960's following a sea storm (Wreschner 1977, 1983). During 1968, a small rescue excavation was carried out on the shore, in the central area of the site. During the years 1983-1995 sections of the submerged southern part of the site were exposed. Underwater rescue surveys carried out by the IAA and the University of Haifa (Galili – Weinstein-Evron 1985; Galili et al. 1993) revealed wall sections and installations, paved surfaces, stone built graves and skeletal remains buried in the clay, pottery vessels (Fig. 21), flint and stone artifacts and plant remains. During 2005, a large section of the central part of the site was exposed in the shallow sea (depth 0-1 m. below present mean sea level). Foundations of rectangular structures were uncovered. Subsequently, over a seven year period (1989-1995), archaeological remains were collected from the submerged section of the site during underwater surveys carried out by members of the Underwater Unit of the Israel Antiquities Authority.

- **Architectural finds.** In the north section of the site, foun-







Fig. 22: Rectangular dwellings.



Fig. 23: A pottery vessel with incised fish figures and herringbone design.

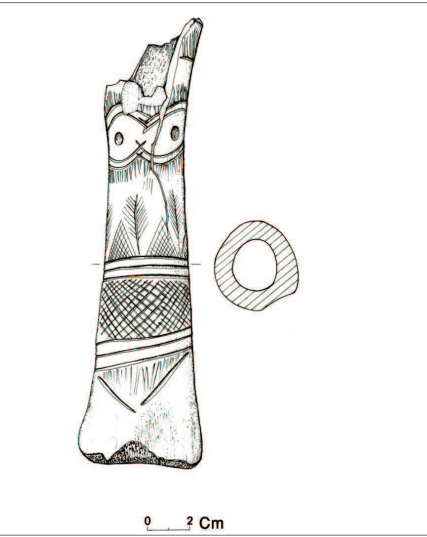


Fig. 24: Anthropomorphic bone figurine from Neve-Yam graveyard area.



Fig. 25: Anthropomorphic figurine made of green stone from Neve-Yam south site.

datations of rectangular structures and wall fragments (ca. 0.5 m in width) built of two rows of undressed sandstone stones were observed (Fig. 22). Also found were unpaved pits, paved surfaces made of small undressed stones, stone slabs, pottery sherds and postholes, probably of huts. The south section of the site was allocated to stone-built cist graves in an organized pattern (Fig. 19). There is a clear division between the northern section of the site (residential area of the living) and the southern “suburb of the dead”, containing the graves.

- **Flint tools.** The characteristics of the flint assemblage from Neve-Yam are similar to those of other WR sites in the southern Levant. It includes a high percentage of narrow chisels of plano-convex section, adzes, wide but short rectangular sickle blades (backed and truncated), polished bifacial tools with polished working edges, including: adzes, chisels and a low

percentage of axes. Noteworthy is the absence of arrowheads.

- **The ground stone implements** include basalt chalices, basalt and limestone grinding tools, limestone bowls and large kurkar basins. The main raw material for ground stone artifacts at Neve-Yam is basalt. It attests to the extensive trade ties in the PN between the coast and sites in the interior where basalt is found (e.g. Golan Heights and Galilee).
- **The ceramic assemblage** of Neve-Yam South is very similar to that initially collected by Wreschner in the 1960s, and to other WR sites in the Southern Levant. The assemblage consists mainly of bowls, spouted vessels, hole-mouth jars, bow-rim jars and pithoi, all decorated with painted, incised and plastic elements. Of special interest is a sherd fragment with incised fishes and a herringbone design (Fig. 23).
- **Figurines.** A schematic stone anthropomorphic stele made of

kurkar was recovered near the burial area. Another anthropomorphic bone figurine (Fig. 24) and a third anthropomorphic figurine made of green stone (Fig. 25) were also recovered from the site. These may also be associated with the burial ground and represent the symbolic, non-materialistic world of the Neve-Yam population.

- **Botanical remains.** Three large concentrations of charred seeds, possibly associated with the burials, were recovered in Area C (Galili et al. 2009). Concentration #1 (Fig. 19, no. 6) comprised about 300 cc. of seeds mixed with clay, all identified as domesticated lentils (*Lens culinaris* var. *microsperma*). The seeds varied in size and some were infested by pests, probably the beetle *Bruchus* sp. Concentration #2 comprised (Fig. 19 no. 9) about 100 cc. of grains mixed with clay, including seeds of various shapes and sizes that were concentrated in a hearth built of burnt mud bricks. About 90% of the grains were of domesticated barley (*Hordeum sativum* = *H. vulgare* L.). In addition, several seeds of edible plants and wild plants were recovered: domesticated emmer (*Triticum dicocum*), one seed of *Viciaeae*, a few seeds of *Liliaceae* and several unidenti-

fied seeds. Concentration #3 comprised about 300 cc. of seeds free of clay (Fig. 19 no. 39), and was found ca. 1.5 m east of burial H3. This sample consisted of several species of pulses (apparently domesticated) including (by frequency): pea (cf. *Pisum vicia narbonensis*), vetch (*Lathyrus Sect. cercula*), horse bean (*Vicia faba var. minor*), lentil (*Lens culinaris var. microsperma*), domesticated flax (*Linum usitatissimum*), and remains of a few wild plants or weeds (*Galium*, *Lolium* and *Liliaceae*). The presence of field weeds and wild plants in the seed assemblages seem to indicate harvesting in cultivated fields. Barley and the pulses are harvested in the spring, while wheat is usually harvested in early summer. The under-representation of wheat may be of significance hinting at a spring event.

- **Faunal remains.** A small bone sample (NISP = 91 identified bones) was recovered during the 1960s salvage excavation and from collections along the sea-shore by Wreschner, and were described by Horwitz (1988). The subsequent 1989-1885 surveys, yielded larger collections of animal bones that were hand collected during dives. As such, the latter faunal sample primarily consisted of large, relatively complete elements (NISP = 380 identified bones). Both collections were described in a summary paper by Horwitz et al. (2006) and the cattle were specifically discussed in Horwitz – Ducos (2005). Fauna from both collections indicate that the animal economy was based on domestic herd animals: sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*) and pigs (*Sus scrofa*). The few remains of wild species that were recovered: mountain gazelle (*Gazella gazella*), badger (*Meles meles*) and perhaps wild boar (*Sus scrofa f. fer.*), attest to the continuation of hunting, but also to its relative unimportance as a subsistence activity. Only one-third of the ungulates were adults and kill-off patterns indicate that the management was aimed at meat procurement. Analysis of cut marks



Fig. 26: Stone-built cist grave.

indicates that animals were butchered and consumed on-site using a variety of stone tools

(Greenfield et al. 2006). The paucity of fish remains may indicate that the role of fishing was limited but may also relate to the fact that most bones were hand-collected during dives such that the smaller sized fish bones were perhaps overlooked.

- **The burial ground.** The burials were concentrated in a relatively small area (40×70 m) and were probably associated with hearths, paved surfaces and seed concentrations. The graves (Figs. 19, 26), oriented in an east-west direction, consisted of an oval burial chamber lined with undressed stones covered by stone slabs. Some graves were eroded by sea action with only the skeletons and a few stones remaining. Altogether, eleven graves were located; of these two were covered cists, four were uncovered cists, two consisted of a few stones in the clay, and three were pits dug in the clay. Of the eight stone-built

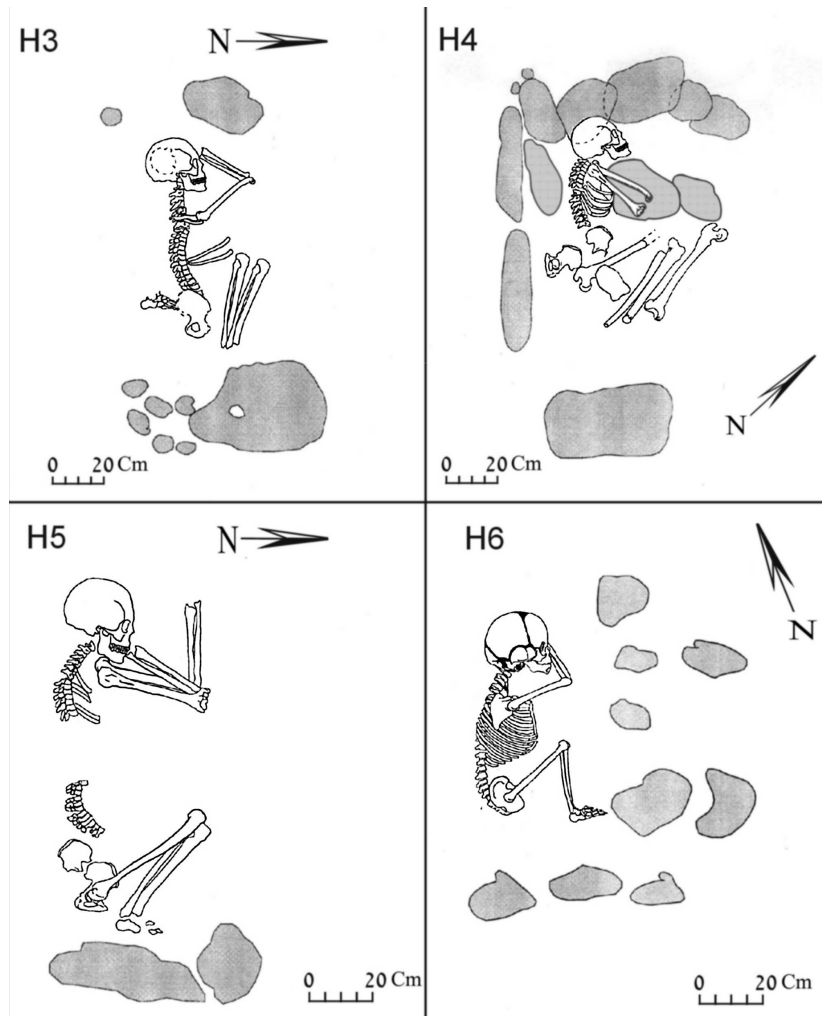


Fig. 27: Burial positions of skeletons from Neve-Yam south site.

graves, four eroded graves were excavated.

- **The human skeletal remains.** The sample consists of an estimated number of 15 individuals (Galili et al. 2009). Eight skeletons – primary or disturbed burials – were recovered from the graves and seven individuals were represented by scattered bones. Four skeletons were buried in a fully flexed position, and four were partly flexed (Fig. 27). Eight children (aged 0-10 years), one adolescent (10-18 years) and 6 adults were identified. Among the adults were three females, one male and two individuals of unknown sex. No charred bones or group burials were found. An unusual pattern of tooth attrition (oblique wear) was noted in one individual suggesting that he used his teeth as a working tool of some kind (Galili et al. 2005).
- No grave offerings were recovered within the excavated graves. However, the three charred seed assemblages found in the vicinity of the graves and the nearby installations may be related to the burials and/or ritual activities (e.g. a ceremonial meal) near the graves.

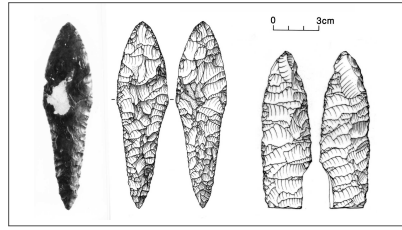


Fig. 28: Flint daggers.

(Garfinkel 1993). The finds from Atlit-Yam suggest that these blades started to appear earlier, during the PPNC. The flint daggers (Fig. 28) found in Atlit-Yam and coastal sites like PPNC Ashkelon and PN Zikim are relatively rare in inland Neolithic sites and it is possible that these tools were associated with the exploitation of marine resources in the coastal sites.

In Neve-Yam, as in other submerged WR sites, there were no arrowheads. This trend is typical to the WR culture suggesting that these settlements relied mainly on agriculture and husbandry and that hunting was limited, a finding corroborated by the faunal assemblages.

The perforated stones found in Atlit-Yam may have been used as fishing net sinkers, while flint and bone tools (dagger, fishing hooks and barbs) (Fig. 29) indicate that fishing was widely practiced.

The ground stone assemblage of PPNC Atlit-Yam mainly included mainly containers such as bowls and cupmarks. Polished pebbles, hammer stones, perforated stones and grinding slabs were also recovered. The ground stone assemblage from PN Neve-Yam included basalt chalices, an abundance of basalt and limestone grinding tools, limestone and large basins made of kurkar stone. The abundance of stone containers in Atlit-Yam compared to the PN Neve-Yam is probably the result of the absence of pottery vessels in the PPNC and the transition to mass production of pottery in the PN. Moreover, in PPNC Atlit-Yam the common raw material used for ground stone artifact manufacture was limestone, but at PN Neve-

Yam basalt was favored. This difference may be due to the more extensive processing of cultivated crops in the PN, with basalt being a more durable raw material than limestone.

### 5.1.1 Ornaments in the submerged settlements

Ornaments and figurines made of stone and bone were discovered both at Atlit-Yam and Neve-Yam. The Atlit-Yam objects include an anthropomorphic figurine depicting a female buttock, a stone phallus, decorated pendants, pendants, decorated discs and rings as well as a decorated anvil (Figs. 5, 11). The Neve-Yam figurines all depict anthropomorphic figures (Figs. 24-25). In Neve-Yam pottery vessels bearing incised and colored decorations were recovered (Fig. 21, 23).

## 5.2 Subsistence economy of the submerged sites

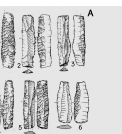
**5.2.1 Botanical remains** were extremely well preserved in the submerged sites. They ranged from wood used in architecture and for manufacture of containers (such as bowls), twigs and reeds used for basketry, and a range of seeds of cultivated and wild plant species that were dietary items, while some served as fodder (Galili et al. 1989, 1993, 1997, 2009; Kislev et al. 2004; Hartman et al. in press). Most common in both the PPNC and PN sites were remains of domestic cereals (wheat, barley,) and legumes (lentils and horse bean), with fruits including olives, almonds, figs, grapes and date. Remains of fodder plants, weeds and flax, used for fiber, were also identified. The presence of installations for producing olive oil, ground-stone artefacts, sickle blades and silos all attest to extensive agricultural activities having taken place at these sites.

**5.2.1.1 The beginning of olive oil extraction.** In striking contrast to the botanical assemblage from PPNC Atlit-Yam, in most PN sites thousands of olive stones were recovered. aDNA analysis of olive pits from PN Nahal Megadim (Elbaum et al. 2006) showed that in some features their sequences

## 5. Discussion

### 5.1 Diachronic changes in lithic and ground stone artifacts

Flint cores in Atlit-Yam reflect the general patterns found in other sites in the Southern Levant. There is a considerable reduction in the amount of naviform cores (for the production of long blades) with time: in PPNB sites there is a high percentage of naviform cores, in PPNC sites including Atlit-Yam, their relative percentage is lower, and in PN sites they are totally absent. It seems that this trend derives from a reduction in the use of long blades with the transition from the PPN to the PN. Sickle blades in PPNC Atlit-Yam were long and delicate and were produced from naviform cores, while in PN Neve-Yam the sickle blades were short and crude. Denticulate sickle blades were reported from early PN, Yarmukian culture deposits



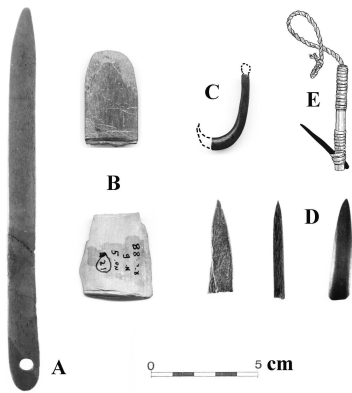


Fig. 29: Fishing implements made of bone from Atlit-Yam: A) needle, B) gauges, C) hook, D) barbs, E) reconstruction of composite barbed hooks.

resembled that of a consensus sequence of modern *Oliva europaea* (73-76% similarity), but they also differed in some base pairs, probably as a result of damage to the DNA. In Kfar Samir an installation for producing olive oil was exposed. It comprised a pit containing thousands of crushed olive stones and traces of pulp, evidently olive oil extraction waste (Figs. 30) (Galili et al. 1997, 1989; Galili – Rosen 2007). The  $^{14}\text{C}$  dates of the olive stones attribute the finds to the PN WR culture. Excavation of another pit at Kfar Samir uncovered water logged pieces of a braided basketry vessel, perhaps an ‘aqual’ (Fig. 13), tree branches and dozens of olive stones. These finds represent the earliest known evidence for olive oil production.

**5.2.2 Faunal remains.** Bones and teeth of animals have been recovered from all six submerged Neolithic sites. The largest assemblages derive from the three sites that have been excavated or the most intensively surveyed and sampled – Atlit-Yam, Neve-Yam and Tel Hreiz. In all instances, bone preservation is excellent with few specimens showing post-depositional abrasion due to exposure to sea and sand action. Exceptions are bones collected on the beach off Neve-Yam and Tel Hreiz. The hand-collected samples from dives show a bias for more complete, larger bones, a factor that has biased the types of skeletal elements found and also species re-



Fig. 30: Evidence for olive oil extraction from Kfar Samir: a) a pit filled with crushed olives, b) crushed olives, c) stone basin possibly for crushing olives.

presented, since remains of smaller taxa such as birds, fish, reptiles and rodents were seldom collected. Remains of the latter taxa were recovered primarily from sieved sediments dredged from the wells. Analysis is still underway for much of the fauna from Atlit-Yam, but faunal assemblages from both PPPNC and PN sites exhibit rich species diversity (Horwitz – Tchernov 1987; Horwitz et al. 2002, 2006; Galili et al. 1993). Despite the chronological differences between them, they represent subsistence economies dominated by herd animals – caprines, cattle and pigs. Based on their morphology and biometry, many of the animals from the surface collections from PPPNC Atlit-Yam resemble their wild progenitors, implying that they are either wild animals or animals in the very early stages of domestication. In contrast, animals recovered from the Atlit-Yam well, which represents the last phase of site occupation, are all domestic forms and resemble those from the submerged PN sites. In addition to herd animals, a considerable quan-

tity of dog remains were found in the PN sites, all of similar size and conformation, representing a breed that is only slightly smaller and more gracile than modern Saluki dogs (Dayan – Galili 2000; Horwitz et al. 2002).

Game animals comprise a minority of finds in all sites, indicating that although hunting continued it served little dietary importance (also reflected in a diachronic drop in the frequency of arrowheads). It may however have played an important symbolic role (such as for grave offerings). People engaged in fishing, as illustrated both by remains of marine and freshwater fish (Zohar et al. 1994, 2001) as well as items of fishing equipment at all sites (Galili et al. 2004, 2013). However, it is difficult to gauge the importance of its contribution, given the methodological problems involved in the recovery of fish bones at these sites. Both the PPPNC and PN sites reflect an integrated agro-pastoral-hunting-fishing subsistence economy although the relative proportions of vegetal versus animal foodstuffs in the diet, is unknown. They serve as the earliest examples of a subsistence form that continues up until today in fishing villages around the Mediterranean.

### 5.3 The emergence of the Mediterranean fishing village on the Levant coast

The Levantine and Cilician (south-east Turkish) seashore areas are the closest coastal environments to the inland regions where animals and plants were first domesticated. At the end of the 10<sup>th</sup> millennium BP, a mixed mode of subsistence that included farming-animal husbandry-hunting-fishing evolved among indigenous coastal inhabitants on the Levantine coast as evidenced by the material recovered from Atlit-Yam (Galili et al. 2002, 2004), and possibly also at the sites of Ashkelon Marina on the southern Israeli coast (Perrot – Gopher 1996; Garfinkel – Dag 2008) and Ras Shamra on the Syrian littoral (Van Zeist – Bakker-Heeres 1984; Helmer 1989). Living





on the coast provide diverse environmental niches and many possibilities of exploiting terrestrial and marine resources (Fig. 31). The agro-pastoral components of this subsistence system relied on cultivation of domesticated cereals and legumes, herding of domestic sheep, goats, cattle and some hunting of game, with the added exploitation of marine resources, primarily fish. Based on the analysis of material from Atlit-Yam, it appears that the site closely fits many of the criteria outlined by Butzer (1996) as characterizing the modern Mediterranean Fishing Village and represents one of the earliest sites of its kind (Galili et al. 2002, 2004, 2005). Subsequently, this coastally adapted subsistence system spread westward throughout the Mediterranean basin (Galili et al. 2002, 2004). Examining the seasonality and economic input of the subsistence activities occurring in Atlit-Yam over the year, demonstrates that it was possible to combine land-based subsistence activities and marine resources, and thus be sedentary in the site all year round.

During the 5<sup>th</sup> millennium cal. BC, olive oil extraction was added to the economy of the PN sites on the Carmel coast (Galili et al. 1997). The subsistence of the PN settlements was characterized by increased reliance on farming and animal husbandry reduction in the exploitation of marine resources and hunting, and intensive use of secondary animal products (milk products, wool fibers etc.). Later still, during the 4<sup>th</sup> millennium cal. BC, more plants such as the domesticated vine which enabled the production of wine in the Levant were introduced (Zohary – Hopf 2000). By 3000 cal. BC, what is today commonly termed ‘the typical Mediterranean diet’ was crystallized (Butzer 1996; Galili et al. 2002, 2005).

#### 5.4 The domestication of water on the Carmel Coast, Malaria and Environment

The transition to sedentism and food production in the Levant was associated with an increase in

infectious diseases, including tuberculosis and malaria (Smith – Horwitz 2007; Eshed et al. 2010). Malaria once a major cause of human death and degeneration is still a major health concern. In 1991 it was shown that malaria was present in the PPNC site of Atlit-Yam based on the presence of a skeletal deformation characteristic of clinical Thalassemia. It was suggested then that mosquitoes from the marshes in the vicinity of human habitations were a cause (Hershkovitz et al. 1991). Further studies, now being conducted, suggest that the constructed water wells, as well as other anthropogenic modifications to the local environment, may have played a part in the spread and the virulence of malaria in Neolithic sites along the Carmel coast. This thesis is supported by studies on the ecology of malaria showing the role of various environmental factors associated with the complex of man-water-mosquitoes-swamps (Learmouth 1977; World Health Organization 2012).

#### 5.5 Changing Neolithic burial practices

The Neve-Yam site contributes new insights about burials practices in the Southern Levant. In PPNC Atlit-Yam, burials are lacking grave structures, and are scattered all over the site (Galili et al 2005; Eshed – Galili 2011). At PN Neve-Yam, the graves are stone-built cists that are a clear change from the PPN burial traditions. Stone built cist graves first appeared at the very beginning of the PN at Byblos (Dunand 1973), Sha’ar Hagolan in Israel (Stekelis 1972) and Tabaqat Al-Buma in Jordan (Banning 1995). The significance of the Neve-Yam burials is the organized pattern and their concentration in a separate section. This was accompanied by symbolic activities associated with the burials. The clear separation of an organized burial area, with standardized grave types from the dwelling zone, accompanied by ritual and symbolic activities, should be considered evidence of a graveyard (Galili et al 2009). This

phenomenon is unknown in other PN sites in the region. It is significant because it could be a precursor of the later Ghassulian (Late Chalcolithic), separate graveyards (Levy 1995). The separation may be associated with intensive surface and sub soil-disturbing activities associated with sedentism and agriculture, such as: digging wells and pits, house foundations, planting and hoeing. Such activities could have provoked friction between sub-soil use for burials, and its systematic disturbing by the living. The motivation to move to separated burial grounds could have been associated with the necessity to resolve this territorial friction between the living and the dead over the use of sub-surface space. This new arrangement evolved into a separate, non-residential precinct: “the graveyard”.

#### 5.6 Paleodemography in the submerged sites

Paleodemographic study of three southern Levantine Neolithic populations (Atlit-Yam - 65 individuals, Neve-Yam - 13 individuals, and a group of PPN sites - a large sample comprising skeletal remains of 271 individuals) show that the mortality pattern of the Atlit-Yam population differed from that of the PPN populations and from that of Neve-Yam. Atlit-Yam population had high mortality rates in the old age cohort (over 50 years) but slightly higher life expectancy at birth (25.7 years vs. 22.9; Eshed – Galili 2011). The differences are attributed to dietary and environmental dissimilarities. The combined agro-pastoral-hunting-marine subsistence and sedentary way of life, first initiated at Atlit-Yam, may have provided a more stable food supply and more balanced nutrition than in the preceding PPN and later PN periods. Specifically, the regular and frequent consumption of marine resources and animal proteins would have provided a rich supply of protein, fat and micronutrients, while agriculture increased but fishing reduced in the PN (Galili et al. 2005).



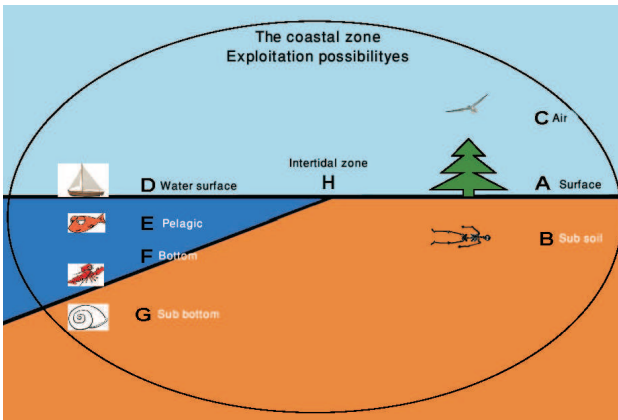


Fig. 31: Cross section demonstrating exploitation possibilities of terrestrial and marine resources in a coastal site.

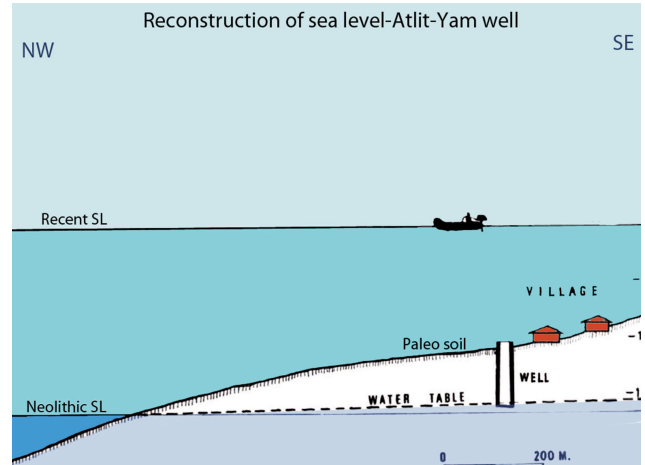


Fig. 32: Reconstruction of sea-level at time of occupation in Atlit-Yam.

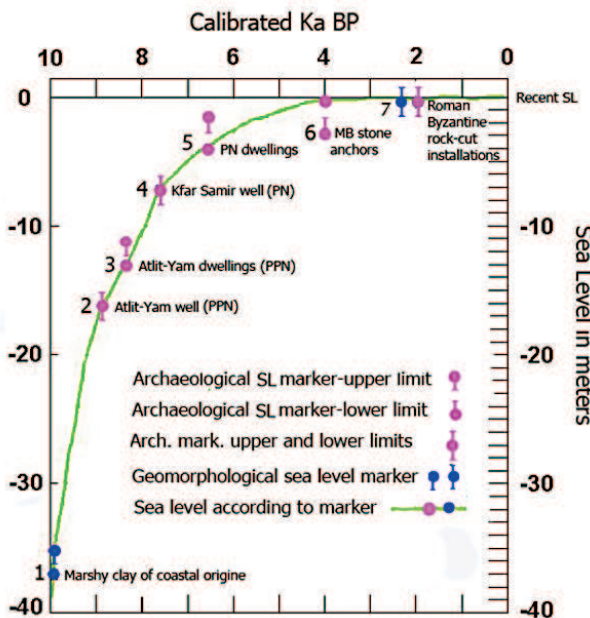


Fig. 33: A curve showing the sea-level changes in the Carmel coast based on archaeological markers.

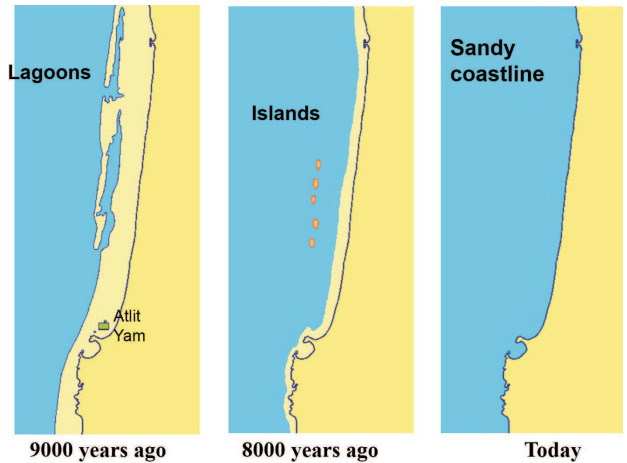


Fig. 34: Coastal changes in the northern Carmel coast in the last 9000 years.

5.7 Sea-level and coastal changes in the Carmel coast

5.7.1 Coastal wells. The Pleistocene coastal aquifer of Israel drains westward toward the Mediterranean. Observations of recent Israeli coastal water wells show that the groundwater table in these is very close to, or slightly higher than, the present sea level. The natural groundwater table slope in the Israeli coastal plain is in the order of 1:1000 (Kafri – Arad 1978). Thus, the groundwater table for a well that is situated 500 m inland from the shoreline would be 0.5 m above sea level. Studies of ancient wells along Israel’s coastal plain have shown that the average freshwater

depth at the bottom of the wells was about 0.6 m (Nir – Eldar-Nir 1986, 1987, 1988). This column height is dictated by people’s ability to dig beneath the water table, and by the fact that it was not necessary to have a deeper water column. An average water column of 0.6 m will generally supply an adequate amount of fresh water. The Atlit-Yam well bottom is about 15.5 m below modern sea level. This suggests that during the well’s initial use, sea level was probably around 16 m (and certainly no more than 15 m) below present sea level (Fig. 32). Observations from the Kfar Samir submerged well indicate that during the PN, sea level in the Carmel area was 8-9 m

lower than today (Galili et al. 1988, 2005; Galili – Rosen 2011a). A rise in sea level would have resulted in a rise in the groundwater table and possible salination of wells in the currently submerged sites. In Atlit-Yam well 11, evidence for such salination and attempts to cope with it were identified (Galili – Rosen 2011b).

5.7.2 Sea-level changes and coastal modifications. Combining these observations with bathymetrical and geological maps of the area enables a reconstruction of the sea-level and coastline changes along the northern Carmel area (Galili et al. 1988, 2005) (Fig. 33). At the beginning of the Holocene, when

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### Ein gelungenes Experiment zur Steinzeit-Seefahrt

Unsere Leser werden sich erinnern, dass in Jahrgang 9, 2009 Heft 2 auf Seite 187 dieser Zeitschrift ein kurzer Bericht darüber erschienen ist, dass Archäologen an der Südküste Kretas Steingeräte entdeckt haben, die wegen der geologischen Schichten, in die sie eingelagert waren, mindestens ca. 130.000 Jahre alt sein müssen. Da Kreta aber nie mit dem griechischen Festland verbunden war, folgt aus dem Befund, dass der Mensch bereits in der Altsteinzeit in der Lage war, wenigstens kürzere Strecken übers Meer zu fahren. Soeben berichtete nun die in Athen erscheinende deutschsprachige *Griechenland Zeitung* in Jahrg. 10, Ausgabe 441 von einem Experiment, das eine Gruppe namens „The First Mariners“ erfolgreich durchgeführt hat. Es ist ihr gelungen, mit einem Floß in zwei Tagen von der südlich der Peloponnes gelegenen Insel Kythera zum westlichen Ende Kretas zu fahren und in den Hafen von Chania einzulaufen. Das Fahrzeug von 11 m Länge und 2,40 m Breite sei aus vier Zypressenstämmen, einer Masse Schilfrohr, Seilen und Ziegenleder erbaut worden, also aus Material, das auch Steinzeitmenschen verfügbar war. Dasselbe gilt für den Proviant: Nüsse und andere Früchte, Honig, Eier und Fisch sind für Wildbeuter typische Nahrung. Der Fortbewegung dienten Riemen und ein Segel aus Schilfgeflecht. Man darf auf nähere Einzelheiten zu Bauweise und nautischen Fähigkeiten des Floßes gespannt sein. Dass floßartige Fahrzeuge schon sehr früh der Menschheit zur Überwindung von Gewässern gedient haben, hat bereits vor vielen Jahren der Pionier der Unterwasserarchäologie und geistige Mitbegründer der DEGUWA, Gerhard Kapitän, vermutet.

Weiteres zu den „First Mariners“ und ihren Projekten:

[www.thefirstmarinerexpeditions.com/](http://www.thefirstmarinerexpeditions.com/), wo auch einiges Bildmaterial zu finden ist.

C.B.

sea-level, relative to the present one, was lower by tens of meters, the coastline was located some 3-4 km west of the present one. Between 9200 and 8000 BP, sea-level was about 16 m below the present height and the coastline north of Nahal Oren was extensively indented, creating lagoons and shallow bays but south of Atlit the coast was sandy and straight. Between 7000 and 6500 BP the sea was about 9 m below present sea-level. A row of offshore islands was situated parallel to the coast from Atlit northward, while to the south the coast was straight and sandy (Fig. 34). Geomorphological sea-level markers in the Carmel Coast indicate that sea-level rose from -35 to -7 m between 9000 and 6500 BP, at a rate of 11-13 mm per year. Between 6800 and 4000 BP sea-level rose from -7 to the present level at a rate of 2.5-3.5 mm per year. During the Chalcolithic period (6000-5700 BP) sea-level was about 2.5-5 m lower than today. In the Middle Bronze Age (~4000 BP) the sea reached its present level and the coastline reached its present form. Since the Middle Bronze Age sea-level has been relatively stable with possible fluctuations of no more than 0.5 m. The ruins of the oldest submerged settlement in the study area, Atlit-Yam, dating to the PPNC (ca. 9200 - 8200 BP), are located in deeper water and farther off-shore than the later PN settlements. These parameters indicate that the early Neolithic settlements were abandoned due to sea-level rise and settlement moved eastward further into the interior.

### 5.8 The destruction/abandonment of the submerged settlements

It has been suggested that the Atlit-Yam village was destroyed by a catastrophic tsunami event generated by the collapse of a section of Mount Etna (Sicily) into the sea (Pareschi et al. 2006, 2007). However, based on current archaeological records from the site and its surrounding, no indications of a tsunami were found. The geological evidence shows no evidence of tsunami sediments. Moreover, the

human remains found are almost all in *in situ* graves, well preserved with no traumatic injuries evident on the skeletons as expected in a tsunami. Likewise, all faunal remains represent refuse typical of consumed animals (Greenfield et al. 2013) and no complete, articulated carcasses were found, as would be expected if they died in a devastation, such as a tsunami. It appears that the Atlit-Yam site and probably the other PN submerged settlements off the Carmel coast, were abandoned gradually due to a global sea-level rise, rather than as a result of a catastrophic tsunami event/s (Galili et al. 2008).

### 5.9 The potential for finding submerged prehistoric settlements

The greatest potential for finding submerged Neolithic settlements is in areas where special geological, environmental and cultural factors have combined. Such sites are located near the coast, where natural factors or human actions cause erosion and exposure of palaeo-soils. At times, the fringes of such sites can be traced on land. Thus, surveys and excavation efforts should be concentrated in areas with these characteristics. An example of such conditions is found at water depths of 1-10 m off the Carmel coast, where the sediment cover is not too thick (enabling exposure) but also not too thin (enabling preservation). In the Neve-Yam and Tel Hreiz sites, sections of the submerged settlements were first identified on land (Wreschner 1977a, 1977b, 1983; Ronen – Olami 1978; Olami 1984). However, most of the cultural deposits, structures and artifacts from the submerged prehistoric sites off the Carmel coast were discovered in the course of pre-planned, systematic underwater surveys and excavations, undertaken since 1965 in the most promising areas. Continued investigations along the Carmel coast, especially after storms, have yielded remains of an increasing number of sites and exposed new areas of existing ones.

## 6. Conclusions

- During the post glacial inundation, most coastal Holocene sites around the world underwent severe erosion but in the case of the Carmel coast, sediment covered the sites before inundation and protected them from marine erosion.
- Excavations of the inundated settlements off the Israeli Carmel coast demonstrated the development of a society moving toward a fully sedentary lifestyle in a Mediterranean fishing village. Throughout this process, the diet of the settlements inhabitants depended on a combined regime of agropastoral-hunted and marine resources.
- Apparently the sites were abandoned gradually as a response to sea-level rise, not as a consequence of dramatic flooding or tsunamis.
- Unique feature of the submerged sites is the knowledge of water wells digging technology as early as the end of the 10th millennium cal. BC.
- The Neve-Yam organized graveyard with its stone-built cist graves covered by slabs and organized in a pattern and associated rituals appears to have been an innovation of the PN.
- The appearance of a separate burial grounds in the PN, was probably a mechanism to resolve the conflict between the dead and the living on the use of the subsoil.
- The agricultural products, offerings or leftovers of ritual or ceremonial feasts/meals close to the graves may reflect the later well-known practice of offering part of the harvest and herd to the ancestors and gods as reflected in local archaeology, regional myths and biblical sources.
- Paleoenvironmental information derived from this research includes documentation of sea-level rise, coastal changes, land use patterns and health status.
- Numerous environmental and cultural-historic conclusions can be drawn from the rich *in situ* record of architecture, burials, faunal and floral remains





found by archaeologists equipped with standard scuba diving equipment.

- The submerged Neolithic coastal settlements off the Carmel coast holds important information for understanding the origins, development and diffusion of the Neolithic way of life in the Old World.

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### Note

<sup>1</sup> The Wadi Rabah (WR) culture is attributed by some scholars to the late PN period (Gopher – Gophna 2003) and by others to the Early Chalcolithic period (Garfinkel 1999).

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#### Abbreviations

*AmJPhysAnthr* = American Journal of Physical Anthropology

*HA* = Hadashot Arkheologiyot

*JASc* = Journal of Archaeological Science

*JFieldA* = Journal of Field Archaeology

*JIPS* = Mitekufat Haeven, Journal of the Israel Prehistoric Society

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### Credits of figures

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