Sea level rise in pre-history

Ancient defence against invasion by the sea has been uncovered

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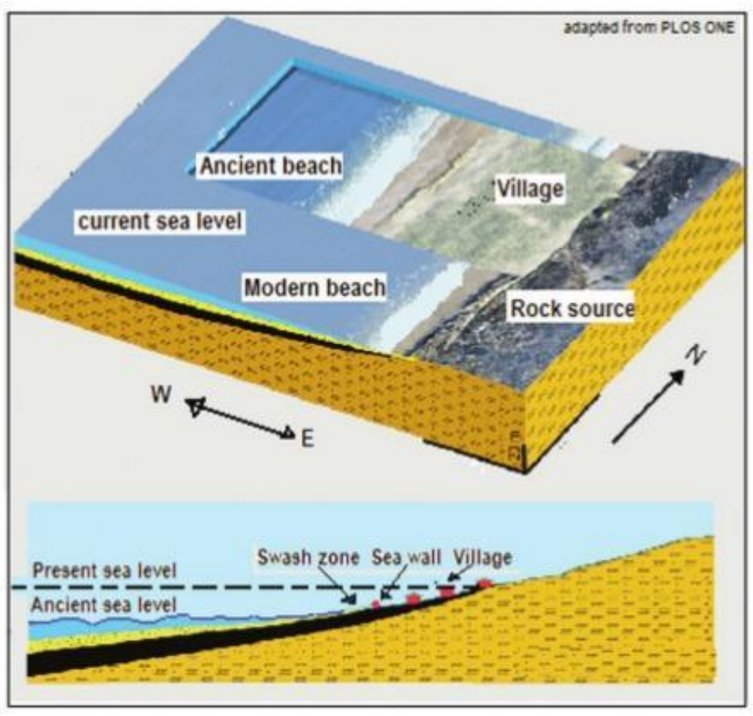
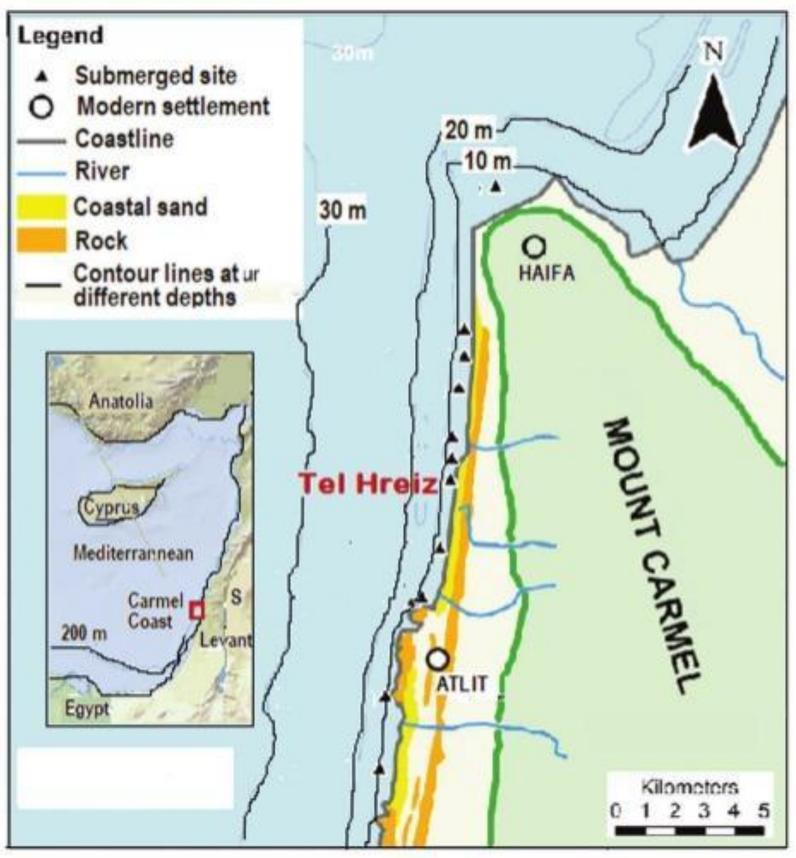
Coastal cities are in danger because the sea level is set to rise through the rest of the century. It has become urgent that states find methods to cope, if not to relocate.

It would appear that people living along the Mediterranean coast made similar efforts as long as 7,000 years ago. Ehud Galili, Vered Eshed, John McCarthy and Liora Kolska Horwitz from the Universities of Haifa, the Hebrew University and the Israel Antiquities Authority, Jerusalem, Jonathan Benjamin from Flinder's University of Adelaide, and Baruch Rosen, a researcher in Petah Tikva, Israel, describe, in the journal *PLOS ONE*, new discoveries at the submerged Neolithic settlement of Tel Hreiz, off the Carmel coast, Northern Israel. Underwater archaeological investigations, the paper says, have revealed a 100m long, boulder-built seawall, apparently to protect the settlement from sea level rise caused by melting glaciers, between 12,000 and 7,000 years ago.

During the Ice Ages, seawater was trapped in the form of ice, in glaciers, and this led to drop of sea levels. The last Ice Age peaked about 25,000 years ago. After the peak, there was melting and retreat of glaciers, which led to rising of sea levels. Ice Ages are believed to arise, and recede, due to cycles in the plane of the earth's orbit around the sun. The current geological age, which has been consistently warm, and has supported the growth of civilisation, is known as the Holocene (or recent) Age. The Holocene is considered an "inter-glacial" age, i.e., before the next Ice Age, in some thousands of years.

Humans are known to have become the dominant species after the end of the last Ice Age. Continued good climate helped agriculture to develop, the creation of settlements and the beginnings of cities. The rising sea levels during the final stages of the melting of the glaciers, however, submerged some coastal habitation sites and there are numerous instances in different parts of the world. Tel Hreiz, in the Mediterranean, is one such, discovered by accident in 1960, when divers were looking for shipwrecks. Tools made of flint and human skeletons were found, but the site created no archeological interest.





The changes in sea levels and the progress inland of the seacoast, since 9,000 years ago, has been well documented, the paper says. Over the first 2,000 years, at the rate of 4mm a year, the sea level rose by 8m, and again by 8m over the next 3,000 years. Studies of ancient sites submerged in the process show a pattern, that the older sites are found in deeper water and further into the sea, the paper says. The earliest site, some 9,000 years old, is 200-400m into the sea and 8 to12m below the sea level. And there are 15 other sites, which are less than 8,000 years old, less than 200m off-shore and less than 5m under water, the paper says.

The sites were not systematically investigated, but human activity and sea storms accidentally washed aside the sand that had covered (and hence protected) the sites and exposed them to view. In the case of the Tel Hreiz site, natural processes have revealed archeological material extending from the current coastline to a depth of 4 m, the paper says. And a winter storm in 2012, and another in 2015, washed away more of the sand and revealed a formation of rocks, which raised questions of how the formation came about and what it was meant for.

As the action of waves causes erosion and would wear away the details of archeological remains, it is fortunate that these sites were protected by a layer of clay and sand, the paper says. While removal of this layer, for study, is laborious, archeologists make the best of events like storms that expose the features of interest.

In the case of the rock formation at Tel Hreiz, the formation is partly visible during low tide, but the surf interferes with examination and study. Study was hence carried out by scuba divers while the rocks were submerged, during high tide, and the sea was calm. And it was important to carry out the study as fast as possible, before rocks corroded or other remains were moved about by currents.

The boulder-built, wall feature at Tel Hreiz is usually covered by 3m of sand, but they were uncovered during the storms of 2012 and 2015, which provided opportunities for study. During these studies, the exposed section of the wall was measured, drawn to scale and photographed, all features were documented and its precise location was noted. By aerial surveys of the modern beach, coastal ridge and immediate offshore area, the physical environment of the boulder-built feature was reconstructed, to help understand its function.

The underwater survey and the items salvaged, the paper says, disclose a thriving settlement, some 11,000 square meters in area. The finds include structures like a building, huts, tools and implements made of flint, human skeletons, possible burial places, remains of domestic and hunted animals, marine and fresh-water fish and olive pits, which suggest oil extraction. The appearance is of a single, sedentary community, engaged, like others in the region, in agriculture, raising animals and fishing. And based on Carbon Dating, that it lasted 300-500 years.

Now, coming to the boulder-built wall structure, this consists of sections in a straight line, extending to more than 100m, on the eastern, seaward side of Tel Hreiz. It is about 3m below the water, some 90m offshore and parallel to the coast. The southern end is buried in the sand and may continue for a considerable distance. From the arrangement, nature and size of the stones, it is evident that "the boulder-built feature is a continuous and unified architectural entity which forms a wall," the paper says.

The stones are mostly large boulders, 200 to 1,000kg in weight, naturally rounded and not cut or quarried, and appear to have been transported from sources at some distance. This indicates that it was by a well-organised community that the wall had been built. It also appears that at the seaward side of the wall was a swash zone, a beach area alternately covered and exposed by waves.

If this was the case, it is unlikely that the wall was a field boundary or a place for keeping animals. As there are structures that may have been dwellings to the east of the wall, it does appear that the wall was meant to protect and separate the settlement from the open sea.

The structure seems clearly to be a wall constructed by the community for protection, against what would have been seen, over generations, as an advance of the seafront towards the village. The structure may have been effective only for some time, as it was submerged, and there is evidence to that show that Tel Hreiz later moved 50 to 200m to the east.

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Another ape that stood upright

Here's why some scientists want to rewrite the history of how we learned to walk but they may not be entirely correct

VIVIEN SHAW & ISABELLE CATHERINE WINDER

The fossilised remains of Danuvius guggenmosi

The 'walking gorilla' Ambam is famous for his 'human-like' stride

It's not often that a fossil truly rewrites human evolution, but the recent discovery of an ancient extinct ape has some scientists very excited. According to its discoverers, *Danuvius guggenmosi* combines some human-like features with others that look like those of living chimpanzees. They suggest that it would have had an entirely distinct way of moving that combined upright walking with swinging from branches. And they claim that this probably makes it similar to the last shared ancestor of humans and chimps.

We are not so sure. Looking at a fossilised animal's anatomy does give us insights into the forces that would have operated on its bones and so how it commonly moved. But it's a big leap to then make conclusions about its behaviour, or to go from the bones of an individual to the movement of a whole species. The *Danuvius* fossils are unusually complete, which does provide some vital new evidence. But how much does it really tell us about how our ancestors moved around?

Danuvius has long and mobile arms, habitually extended (stretched out) legs, feet, which could sit flat on the floor, and big toes with a strong gripping action. This is a unique configuration. Showing that a specimen is unique is a prerequisite for classifying it as belonging to a separate, new species that deserves its own name.

But what matters in understanding the specimen is how we interpret its uniqueness. *Danuvius*'s discoverers go from describing its unique anatomy to proposing a unique pattern of movement. When we look at living apes, the relationship between anatomy and movement is not so simple.

The *Danuvius* find actually includes fossils from four individuals, one of which is nearly complete. But even a group of specimens may not be typical of a species more generally. For instance, humans are known for walking upright not climbing trees, but the Twa hunter-gatherers are regular tree climbers. These people, whose bones look just like ours, have distinctive muscles and ranges of movement well beyond the human norm. But you could not predict their behaviour from their bones.

Every living ape uses a repertoire of movements, not just one. For example, orang-utans use clambering, upright or horizontal climbing, suspensory swinging and assisted bipedalism (walking upright using hands for support). Their movement patterns can vary in complex ways because of individual preference, body mass, age, sex or activity.

Gorillas, meanwhile, are "knuckle-walkers" and we used to think they were unable to stand fully upright. But the "walking gorilla" Ambam is famous for his "human-like" stride.

Ultimately, two animals with very similar anatomies can move differently, and two with different anatomies can move in the same way. This means that *Danuvius* may not be able to serve as a model for our ancestors' behaviour, even if its anatomy is similar to theirs.

In fact, we believe there are other plausible interpretations of *Danuvius*'s bones. These alternatives give a picture of a repertoire of potential movements that may have been used in different contexts.

For example, one of *Danuvius*'s most striking features is the high ridge on the top of its shinbone, which the researchers say is associated with "strongly developed cruciate ligaments", which stabilise the knee joint. The researchers link these strong stabilising ligaments with evidence for an extended hip and a foot that could be placed flat on the floor to suggest that this ape habitually stood upright. Standing upright could be a precursor to bipedal walking, so the authors suggest that this means *Danuvius* could have been like our last shared ancestor with other apes.

However, the cruciate ligaments also work to stabilise the knee when the leg is rotating. This only happens when the knee is bent with the foot on the ground. This is why skiers who use knee rotation to turn their bodies often injure these ligaments.

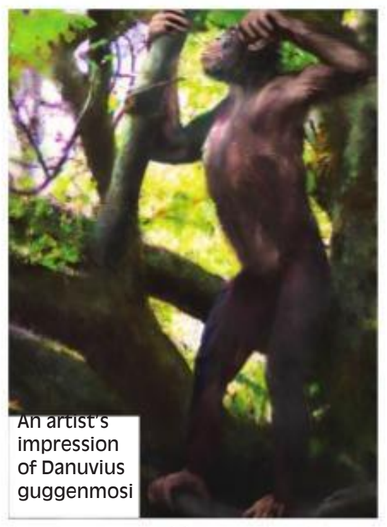
Other explanations

We have not seen the *Danuvius* bones in real life. But, based on the researchers' excellent images and descriptions, an equally plausible interpretation of the pronounced ridge on the top of the shinbone could be that the animal used its knee when it was bent, with significant rotational movement.

Perhaps it hung from a branch above and used its feet to steer by gripping branches below, rather than bearing weight through the feet. This could have allowed it to capitalise on its small body weight to access fruit on fine branches. Alternatively, it could have hung from its feet, using the legs to manoeuvre and the hands to grasp.

All of these movements fit equally well with *Danuvius*' bones, and could be part of its movement repertoire. So there is no way to say which movement is dominant or typical. As such, any links to our own bipedalism look much less clear-cut.

Danuvius is undoubtedly a very important fossil, with lots to teach us about how varied ape locomotion can be. But we would argue that it is not necessarily particularly like us. Instead, just like living apes, *Danuvius* would probably have displayed a repertoire of different movements. And we can't say which would have been typical, because anatomy is not enough to reconstruct behaviour in full.



An artist's impression of Danuvius guggenmosi

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PLUS POINTS

What they ate

Scientists have revealed what they believe fed the "voracious" supermassive black holes that emerged in the early universe. Astronomers have long wondered how the gigantic gravitational singularities could have grown so large so soon after the universe began — in a matter of only hundreds of millions of years—at the same time as the galaxies around them were also able to form. Now, by analysing the cores of more than two dozen galaxies as they appeared some 12.5 billion years ago, they think they have found the answer.

The researchers, writing in *The Astrophysical Journal*, say the "food stashes" that powered the young universe have turned out to be enormous reservoirs of hydrogen. After surveying 31 quasars they found 12 surrounded by the dense, cool clouds of gas, which constituted "the perfect food source" for black holes.

Quasars are the intensely bright collections of swirling matter thought to surround supermassive black holes at the centre of some galaxies. While easily spotted due to their luminance, the cool gas clouds surrounding their galaxies are more difficult to see. The scientists used the Muse attachment of the European Southern Observatory's Very Large Telescope to make their observations.

Emanuele Paolo Farina, of the Max Planck Institute for Astronomy in Germany, said, "The presence of these early monsters, with masses several billion times the mass of our sun, is a big mystery. We are now able to demonstrate, for the first time, that primordial galaxies do have enough food in their environments to sustain both the growth of supermassive black holes and vigorous star formation.

"In a matter of a few hours per target, we were able to delve into the surroundings of the most massive and voracious black holes present in the young universe. While quasars are bright, the gas reservoirs around them are much harder to observe. But Muse could detect the faint glow of the hydrogen gas in the halos, allowing astronomers to finally reveal the food stashes that power supermassive black holes in the early universe."

the independent

E-plane takes off

The world's first fully electric commercial aircraft took its inaugural test flight recently, taking off from the Canadian city of Vancouver and offering hope that airlines may one day end their polluting emissions.

"This proves that commercial aviation in all-electric form can work," said Roei Ganzarski, chief executive of Seattle-based engineering firm magniX. The company designed the plane's motor and worked in partnership with Harbour Air, which ferries half a million passengers a year between Vancouver, Whistler ski resort and nearby islands and coastal communities.

Ganzarski said the technology would mean significant cost savings for airlines — not to mention zero emissions. "This signifies the start of the electric aviation age," he told reporters.

Civil aviation is one of the fastest growing sources of carbon emissions as people increasingly take to the skies and new technologies have been slow to get off the ground. At 285 gm of CO_2 emitted per kilometre travelled by each passenger, airline industry emissions far exceed those from all other modes of transport, according to the European Environment Agency. The emissions contribute to global warming and climate change, which scientists say will unleash ever harsher droughts, superstorms, and sea-level rise.

The e-plane — a 62-year-old, six-passenger DHC-2 de Havilland Beaver seaplane retrofitted with an electric motor — was piloted by Greg McDougall, founder and chief executive of Harbour Air. "For me that flight was just like flying a Beaver, but it was a Beaver on electric steroids. I actually had to back off on the power," he said.

McDougall took the plane on a short loop along the Fraser River near Vancouver International Airport in front of around 100 onlookers soon after sunrise.

AFP