SCIENCE

Unearthing the Original Mediterranean Diet

An archaeologist works to find out how much fish ancient Greeks ate

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After 30 years of research, a Greek archaeologist can tell today's fishery biologists how bountiful the Mediterranean Sea once was. Georgios Tsichlis / Shutterstock

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On the eastern end of the Greek island of Crete, archaeologist Dimitra Mylona steps out onto the dun-colored remains of the 3,500-year-old Minoan settlement of Palaikastro and considers the past. Not just the big-*P* past that is the fundament of her career but also the small-*p* past of her own route to truth through a discipline burdened by myth and speculation. For the past 30 years, Mylona has been testing and refining her methodology, sifting through sites to ever-finer degrees. And if there's anything the past few decades have taught her, it's that the closer you look at ancient Mediterranean civilizations, the more the fish rise to the surface.

Mylona is a zooarchaeologist—a specialist in the study of animal remains of ancient societies. Through the close observation of bones, shells, and other finds, zooarchaeologists try to re-create a picture of the way humans hunted, husbanded, ate, and more generally interacted with the animals around them. Traditionally, zooarchaeologists in the Mediterranean have focused on goat and sheep and other forms of terrestrial protein as the go-to meat sources for Greece and other Mediterranean countries. Back in 1991, as a new graduate student, Mylona thought no differently, imagining herself picking through the remains of livestock. But during one of her first digs, in the same Palaikastro she now surveys, the presence of an entirely different find captivated her—fish bones.

Working by the sea, Mylona and other students were excavating the dirt floors of Minoan houses more than 3,000 years old. To retrieve minuscule finds—carbonized seeds of plants, bits of wood charcoal, bones of birds, lizards, and fish—they sifted the soil by using water to float the smallest of objects to visibility. "One of the senior archaeologists called me over to look into the microscope," she says. "I imagine she was hoping to find someone that would take an interest in something others had

ignored." In the scope was one of the many tiny fish bones that were found that day, probably belonging to a small comber or a wrasse. The senior archaeologist was right. Mylona gazed at the folds and crenulations of those fish vertebrae and mused: a story lurked. She learned during those early digs that archaeologists in Greece were just beginning to employ the much more fine-scale water flotation method to the soils of ancient sites, and as a result more and more fish remains were coming to light. The search for a fishier ancient world, Mylona thought, might be the way forward for her academic career.

Palaikastro, on the Greek island of Crete, is the 3,500-year-old Minoan settlement where ancient fish bones first captivated archaeologist Dimitra Mylona. Peter Maerky / Shutterstock

Setting out to the University of Sheffield in England in the early 1990s for graduate work, Mylona immediately felt resistance to her newfound focus. Her graduate

supervisor advised her against committing to a fish bone master's degree, instead urging her to specialize in the analysis of mammal bones. Fish bones were a dead end, he maintained. To prove his point, he gave her a book published in 1985 by the historian Thomas Gallant, *A Fisherman's Tale: An Analysis of the Potential Productivity of Fishing in the Ancient World*. The book claimed ancient Greek seas were too poor to support fisheries of significance. For decades, that perceived poorness became the accepted defining characteristic of the Mediterranean in academic circles. Because few rivers flow into the Mediterranean, the sea is considered nutrient-starved and described as containing little phytoplanktonic life—*oligotrophic* in scientific parlance. Without sufficient terrestrial nitrogen and phosphorous, phytoplankton—the very base of the marine food web—are sparse. Indeed, one of the reasons the Med, as researchers affectionately call the sea, shows its clear sapphire face to modern humanity is this paucity of plankton. This "containing little life" framework may be a case of what historical ecologists often refer to as *presentism*—the tendency to view the past through a present-day lens. Presentism or not, the acceptance of the narrative left Mylona perplexed: an entire theory was based on a narrow selection of evidence.

Back in the 1980s, Gallant and others were focused on ancient economies and building models to predict people's dietary behaviors in the past. To Gallant, for example, the evidence suggested that given the relatively high population of the Greek coastlines, there was not enough fish to go around. Goat and sheep obviously filled the caloric deficit. "So any calculation based on the few fish bones that were handpicked in Greek excavations at the time made [fish] a very insufficient source of nutrition," Mylona says.

Mylona at an archaeology site on Crete. Paul Greenberg

Having come from a region in northern Greece where fish is an integral part of modern diets, Mylona felt something was askew with this methodology. Over the course of the next 10 years—while earning a master's and a PhD at the universities of Sheffield, York, and Southampton, and shuttling back to a growing family on Crete—Mylona started assembling the tools she would need to prove the hypothesis of a fishier Mediterranean.

While field excavation is often the most iconic part of archaeology, the real decoding of the evidence usually comes to light in laboratories and offices far away from the site. And so, after we look over Palaikastro, Mylona takes me up along winding roads into the hills of the Lasithi region and eventually brings us to the headquarters of the

organization that has supported Mylona's fish investigations—the Institute for Aegean Prehistory. The institute's Study Center for East Crete (SCEC), funded by the American philanthropist and archaeologist Malcolm Wiener, is perched atop a site with a sweeping view of the Dikti Mountains and has an architecture designed to recall the airy halls of the Minoan palaces. Once inside, Mylona leads me first past archaeologists and conservators patiently piecing together vast jigsaw puzzles of pottery, then past an illustrator pen-and-inking renderings of sculpture, and finally to her office.

"In order to know what you are looking at, you need first to establish a reference collection," she says as she pulls out box after box of bones lining her office shelves. A reference collection is a kind of archive of skeletons that allows zooarchaeologists to compare excavated remains with the bones of present-day creatures. "In Greece in 1993, there was not a single reference collection for fish bones—none whatsoever," Mylona says. "Zooarchaeology is not taught in Greek universities, so there are no university collections of fish skeletons."

During what was the busiest decade of her life, she made regular trips to the central fish market in Crete's second-largest city, Chania on the northwest coast, and to moored fishing boats wherever she found them. She bought all the species of fish she could locate. Then she buried them around her home in the north-central Cretan coastal town of Rethymno. After digging them up months later once bugs and microorganisms had eaten away skin and flesh, Mylona scoured, cleaned, and filed away the fish bones like books in a library. When she deemed her collection big enough, she returned to the bones gathered during her first digs and got down to the serious business of seeing what was what.

Counting ancient fish to establish a baseline for classical fisheries may seem like a rather arcane, academic thing to do during a time of climate crisis and profound environmental disruption. But baselines are important. You cannot restore what you

cannot remember. That said, the historical baseline that Mylona is heroically unearthing is elusive. Even gathering data on the modern baseline—what is in the sea today—is a neglected science. Ringed by 22 nations that have fished with ever-increasing relentlessness, the contemporary picture the scientific literature paints of the Med is grim indeed. According to the Food and Agriculture Organization of the United Nations, in 2019, only 36.7 percent of the assessed stocks in the Mediterranean and Black Seas were fished within biologically sustainable levels. After the Aswan High Dam near the mouth of the Nile in Egypt was completed in 1970, nutrient flow into the Mediterranean Sea from the Nile Delta has been curtailed, shifting the nature of plankton blooms and perhaps the entirety of the marine food web. Many other dams throughout the region have done similar damage.

Invasive species have further plundered the sea. Since the Mediterranean and the Red Seas were connected by the Suez Canal in 1869 to eliminate an expensive shipping detour around the Horn of Africa, hundreds of alien species have flooded the Med, and the sea is now considered the most invaded on the planet. On top of alien species eating their way through the Med's forage fish, some species, such as *Lagocephalus sceleratus*, are dangerously toxic, too.

All of these degradations to a once-productive marine food system are happening in part because, with the exception of small coastal communities, the rest of modern Europe no longer relies on the Med for its survival. If you were to believe the earlier work of other archaeologists, you could be persuaded that this was always the case. The sea may have birthed multiple civilizations, but that's not how early archaeologists and historians, like Gallant, imagined the past; *imagined* being the operative word.

As we continue on our odyssey of eastern Crete, Mylona and I eventually find our way down to Mochlos, a one-time fishing village now turned tourist resort an hour's drive west of Palaikastro—a place that inevitably leads one to compare past and present. We are looking down a steep escarpment out on the bluer-than-blue Aegean, an

embayment of the Mediterranean running between Europe and Asia. Before us is a pair of massive stone fish tanks that have been lying at the seafront for more than 2,000 years. Romans created the pens during their occupation of Greece to support a fishing industry that brought in catches live and stored the most precious fish until they could be sold fresh to highly discerning, and rich, customers. Yet even with the investment in infrastructure made for the sake of seafood, Mylona told me, the fish were important to ancient societies even beyond their role on the plate.

“Fish are different,” she says. “Cattle, sheep, goats—these were all animals used for sacrifice in religious rituals. There was a methodology in how you approached their slaughter and treatment. In classical Greece of the fourth and fifth centuries BCE, and probably also earlier, they were ceremonially slaughtered and eaten. You find their remains on altars, on places of sacrifice, and everywhere within settlements.” But fish, she says, occupied a place in society more closely linked to the day-to-day, something that is only realized when archaeological evidence is put in context of “softer” remains like ancient literature.

“Fish were more secular,” Mylona explains. “Because fish participated in the vignettes of daily life, we find them a lot in the classical theatrical comedies. The fishmonger who is a cheater. Or the ignorant customer. Or the glutton who wants to buy all the fish in the market—a symbol of someone who is totally undemocratic. In comedy, fish are used to convey what is proper social behavior. Fish are the vehicle that transmits this idea.” Yet, as much as fish were relegated to the comedies, Mylona and her reference collection show fish were a very serious part of society.

To prove her point, Mylona takes me back to her laboratory at SCEC to show me how something as simple as using water to wash and sift through archaeological deposits reveals a different world. Once the large pieces are extracted and cataloged in a first pass, the “fines” are put into the water flotation separator. A series of meshes allows researchers to extract the tiniest of bones from dirt and rock. Finally, Mylona lays out

these bits of bones and tweezes them apart, comparing them flake by flake to the bones in her reference collection.

“The thing is that most fish bones are small, especially in this part of the world. Small fish predominate,” she says. But even the larger fish, a grouper of seven kilograms, for instance, leave bones that may be no larger than two centimeters. “You can’t easily see them in the course of an excavation. If you do it out in the open, if the light is not right, and if you are really hot and tired, you may not see it.”

Mylona created a reference collection, a kind of archive of skeletons, that allows zooarchaeologists to compare excavated remains with the bones of present-day creatures. Paul Greenberg

Despite the difficulty, Mylona has been persistent. And the result of all this tedious work was revelatory. At Palaikastro, where fish bones first entered her vision, the four large fish bones that were handpicked in one of SCEC’s buildings were

complemented by 4,000 more when water flotation took place. When Greek archaeologists applied the same methodology to coastal sites in the Aegean and even in many inland locations, fish bones were uncovered by the hundreds or thousands in nearly every location. Fish were clearly an important part of the ancient Greek diet: a vast underestimation of the importance of the sea as a source of food had taken place.

Does this persistent and pernicious misapprehension of the importance of fish in the Mediterranean's past have ramifications for the modern inheritors of the Mediterranean Sea thousands of years later? To probe this question, Mylona turns to her friend Manos Koutrakis who also went down a fishy career path. But where Mylona's fish are in the past, Koutrakis's are rooted in the present.

Koutrakis makes his home in Kavala, in northern Greece, near the villages where both he and Mylona grew up. Kavala sits on the Thracian Sea, a region nourished by three large rivers and the outflow of the Black Sea. All this makes it the most productive body of water in the eastern Mediterranean. Koutrakis is the child of a fisherman who worked those waters for 60 years. He feels the pulse of fishing he did as a child, though today Koutrakis does so as a researcher, collecting Kavala data with his team in the Fisheries Research Institute for all the fisheries of northern Greece. Koutrakis routinely interacts with commercial fishermen, parsing through fish auctions and diving the Med regularly in his quest to keep tabs on the national fishery.

Koutrakis is the first to acknowledge there has been a decline in fish populations in the past 50 years. Whereas pre–Second World War small-scale local fishermen, similar to their ancient counterparts, mainly worked the Mediterranean, the post-war era has seen a superstructure of much larger vessels on top of the preexisting locals. This pressure has squeezed the artisanal sector to an ever-greater degree. The

problem is that scientists—much like archaeologists pre-Mylona—lack baseline data on modern fisheries in Greece.

“The Hellenic Statistical Authority was not considering the catches of vessels under 20 horsepower until 2015,” Koutrakis says. “But most of the Greek artisanal vessels were probably exactly in this category.” Yes, larger vessels have also impinged on the artisanal sector, but that sector is still there and in business. Furthermore, it was only in 2016 when Greece created an online database to collect data with self-reporting of landings from vessels more than 12 meters in length.

The discounting of data from small-scale fishers means that managers in charge of placing limits in areas and during specific seasons for the most sensitive stocks are in part blinded. In fact, this is all part of what is often called the Mediterranean Exception. Whereas fisheries around the world are increasingly moving toward quota management systems that try to allocate the exact tonnage each fisher may take, management in the Med still relies on much less precise methods. Seasonal openings and closures and mesh sizes of nets are the main tools that managers have to work with. Koutrakis needs the equivalent of Mylona’s water flotation method for sifting the small bones of modern Greek fisheries, and he works toward that.

“The solution is to have good scientific data,” Koutrakis concludes. And slowly that data is being amassed. “Since 2017, EU regulations require more effort on the quality of data collected. Scientific working groups are putting in more effort in assessing more stocks in order to know where the problem is,” Koutrakis tells me. But is this enough? Will the gaps be filled too late? Will Mediterraneans lose what remains of their biological heritage before we have anything that resembles what they’re now only starting to understand is the historical baseline?

Any talk of baselines in fisheries inevitably leads to the work of the fisheries scientist Daniel Pauly, a marine biologist at the University of British Columbia. Pauly famously

coined the term shifting baselines back in 1995. The essential premise of the shifting baselines hypothesis is that each successive generation has a diminished view of what constitutes abundance. The memories of the Greek fisherman who might have caught 100 sea bream in an hour are lost to his great-grandson who thinks a 10-fish day is a great success. To understand the actual condition of the sea with respect to the historical baseline, I contact Pauly.

“I don’t accept this idea that the Mediterranean is a poor sea,” Pauly tells me. “This is what people always say—few rivers going into the sea to deliver the nutrients. But we know from Roman records that there was probably a significant population of gray whales in the sea. That these whales brought in nutrients from the wider Atlantic, and through their feces fertilized the sea,” Pauly says. What happened to these whales? “The Romans likely killed them all. Everywhere you look, we have evidence of a more abundant sea.” Sharks are not abundant in the Med, but that’s today. “We just did an analysis of film taken by the Austrian cinematographer Hans Hass in 1942. There are sharks everywhere.”

And what will happen if we never refine our understanding of the historical baseline and use it to set recovery goals for fish abundance and diversity?

“The thing is, you don’t need to have the fish to satisfy most people who visit the Mediterranean. You will have the clear, blue empty water. You will have the seaside developments, this ugly mess of concrete from which people will emerge to swim. You’ll have postcards and souvenirs,” Pauly says. “But you will have no fish. And no one will remember that they were ever there.”

This is, of course, the last thing Mylona wants to see in her home waters. And so, she will keep on cataloging and counting, making a bone-by-bone argument for the legacy of a more abundant Mediterranean. “The interest coming from the European Union is more and more focused on environmental issues,” she tells me. “This is our main problem and that’s where our funding will go. More and more we have to ask

questions that are relevant for today. The biggest challenge for archaeologists today is to build bridges with marine biology and conservation, to find ways to use the archaeological and historical fisheries data in meaningful and useful ways."

The hope and dream is a better memory of the past that will influence our behavior in the future—a baseline shifted back to something closer to the abundance we've lost.

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