

A MULTITUDE OF BYZANTINE ERA BLUEFIN TUNA AND SWORDFISH BONES UNCOVERED IN ISTANBUL, TURKEY

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SUMMARY

*Archaeological excavations conducted between 2004 and 2013 in the Yenikapi neighbourhood of Istanbul have revealed the location of a Byzantine era harbour. Built by Emperor Theodosius in the 4th century CE, it was one of the largest and most important ports in the Roman Empire for nearly eight centuries. Many animal remains have been uncovered, including 150 vertebrae of Atlantic bluefin tuna, *Thunnus thynnus*, and many rostra of swordfish, *Xiphias gladius*. All vertebrae are very well preserved and suitable for both morphological and molecular investigations. Butchery marks and historical accounts of the Ancient Greek and Roman tuna fishery in the region suggest that the vertebrae belonged to tunas caught in the immediate vicinity (Marmara or Black Sea). This discovery is of particular interest for bluefin tuna research, as the species has been essentially absent from the Black Sea since the mid-1980s and very few biological specimens exist from that region. Herein we describe the historical context of the find and discuss its scientific significance.*

RÉSUMÉ

*Des fouilles archéologiques menées entre 2004 et 2013 dans le quartier de Yenikapi d'Istanbul ont fait apparaître l'emplacement d'un port de l'ère byzantine. Construit par l'empereur Théodose au quatrième siècle après Jésus-Christ, il s'agissait de l'un des ports les plus grands et importants de l'empire romain pendant près de huit siècles. De nombreux vestiges d'animaux ont été découverts, dont 150 vertèbres de thon rouge de l'Atlantique (*Thunnus thynnus*) et de nombreux rostres d'espadon (*Xiphias gladius*). Toutes les vertèbres sont très bien conservées et peuvent être utilisées dans les recherches morphologiques et moléculaires. Des marques de boucherie et des récits historiques de pêche de thon de l'antiquité gréco-romaine dans la région donnent à penser que les vertèbres appartiennent aux thonidés capturés dans les environs immédiats (mer de Marmara ou mer Noire). Cette découverte présente un intérêt particulier pour la recherche sur le thon rouge car cette espèce était pratiquement absente de la mer Noire depuis la moitié des années 80 et très peu de spécimens biologiques sont présents dans cette région. La présente analyse décrit le contexte historique de la découverte et expose son importance scientifique.*

RESUMEN

*Excavaciones arqueológicas llevadas a cabo entre 2004 y 2013 en Yenikapi, cerca de Estambul, han revelado la localización de una bahía de la era bizantina. Construida por el Emperador Teodosio en el siglo IV d.c., fue uno de los mayores y más importantes puertos del Imperio Romano durante casi ocho siglos. Se han desenterrado muchos restos de animales, incluidas 150 vértebras de atún rojo del Atlántico, *Thunnus thynnus*, y muchos rostros de pez espada, *Xiphias gladius*. Todas las vértebras están muy bien preservadas y son adecuadas para investigaciones tanto morfológicas como moleculares. Las marcas de carnicería y los relatos históricos de la pesquería de túnidos en Roma y Grecia en la región sugieren que las vértebras pertenecían a atunes capturados en las proximidades inmediatas (mar de Mármara o mar Negro). Este descubrimiento es de especial interés para la investigación sobre atún rojo ya que la especie ha estado esencialmente ausente del mar Negro desde mediados de los 80 y existen muy pocos ejemplares biológicos de dicha región. En este documento se describe el contexto histórico del hallazgo y se discute su importancia científica.*

KEYWORDS

Bluefin tuna, Historical fish distribution, Genetics, Coastal fisheries, Bones, Black Sea, Mediterranean Sea

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1. Introduction

In 2004 development of a new metro and rail station was launched in the Yenikapi neighbourhood of the Fatih district situated in the European side of Istanbul. During early excavations an immensity of artefacts were discovered and development was halted. At which point intense archaeological excavations were initiated by the “General Directorate of Cultural Heritage and Museums of Istanbul Archaeological Museums” and it was quickly determined that the area reserved for development was one of Constantinople’s largest and most important harbours under Byzantine rule. The site was known as the Port of Theodosius during the Byzantine era and Langa Bostanlari during the Ottoman period. Although its whereabouts were recorded in ancient texts and maps, its exact location wasn’t discovered until modern excavations had begun. The excavations grew to an area covering 58000m² wherein 35 shipwrecks were unearthed alongside scores of amphorae, skeletons and cultural artefacts (**Figure 1**). Radiocarbon dating (14C) of animal bones found at the site suggest that all remains found therein date back to the Early Byzantine (4th-7th centuries) and Late Byzantine (15th century) eras (Onar *et al.* 2008). Archeologists have since uncovered what they believe to be the oldest settlements in Istanbul, one of the first city walls to be built in Constantinople and the first Byzantine era galleys every discovered (<http://archive.archaeology.org/0707/abstracts/istanbul.html>). All non-human animal remains (some 150.000 ten litre boxes) were shipped to the Veterinarian Anatomy Faculty facilities of Istanbul University in Avcilar, Istanbul. Among the animal remains were found hundreds of horses, dogs, cats, bears, dolphins, camels and various fish species. Among the most conspicuous fish remains are scores of swordfish rostra and 150 large bluefin tuna (BFT, *Thunnus thynnus*, Scombridae) vertebrae. Archaeological excavations were completed in late 2013. Preliminary analysis has revealed that BFT made up the vast majority of fish remains at Theodosius Harbour, indicating that an active commercial enterprise specialized in the capture and processing of BFT was flourishing during this period.

2. Historical context

Built at the nexus of the east and west, between the Black Sea and the Mediterranean, Constantinople thrived as a commercial center during the 4th century AD and quickly became one of the largest cities in the world. Due to its rapid commercial growth, Emperor Theodosius I commissioned the development of the Harbour of Eleutherius or Theodosius Harbour between 379-395 CE (Muller-Wiener 1998). It was to become one of the largest and busiest ports in Byzantium, if not the world and it had no rival for nearly a millennium. Through this port flowed the commerce of an empire: grains from Egypt, spices and precious stones from the India, silk from China, metals from Europe and slaves from throughout the territories of the expanding empire. Between the 5th and 6th century CE, the city's population grew from 300,000 to some half a million inhabitants. Providing this number of people with food was certainly a challenge for the rulers of the time. Certainly, the bounty of the sea provided a necessary source of protein for the Byzantines. To the west lies the Sea of Marmara, the Dardanelles and the Mediterranean Sea and to the east, the turbulent waters of the Bosphorus Strait and the Black Sea. These waters teemed with fish and porpoises feeding on the riches provided by the collision of the two water bodies. Bluefin tuna in particular were a favourite catch of ancient civilizations in the Mediterranean basin. Ancient Greeks immortalized their respect for the species and fascination for the hunt in works of art and theatre during the 5th and 6th century BCE. So important was the fishery by the 3rd century BCE, their image was stamped into Phoenician currency and commercial trade of the species thrived throughout the entire Mediterranean region (Di Natale 2012). Each year massive herds of bluefin tuna passed by the city of Troy, through Hellespont (now Dardanelles) and into the Bosphorus Strait on their annual migration to and from the Black Sea and the fishery thrived. Forth century BCE food fan, Archistratus had the following to say about the BFT caught near Byzantium: “Let it come to you from lovely (*erateinou*) Byzantium if you desire the best, yet you will get what is good even if it is caught somewhere near this place here. But it is poorer (*kheiron*) the farther you go from the Hellespont (near Byzantium), and if you journey over the glorious courses of the briny Aegean main, it is no longer the same, but utterly belies my earlier praise.” The tuna traps that harnessed the annual bounty of migrating tuna were eventually appropriated by the state and leased to fishermen, providing substantial revenue for both Constantinople and Rome. This practice was such a success that the regulations spread throughout the rest of the empire. By the 9th century CE a new law was required to limit the propagation of tuna traps along the coast and better organize the fishery. Byzantine emperor Leo VI introduced legislation dictating the spacing between traps, the development of factories for processing of fish and storage of equipment between seasons and property rights over tuna traps and their location in the Bosphorus (Bekker-Nielsen and Bernal Casasola 2007; Marzano 2013). This was to become the first law to infringe on the public domain, as defined by Justinian Law, and grant private ownership to stretches of coastline and sea floor.

The city thrived until the 13th century, after which point it weakened under the strain of the crusades and costly conflicts with the Venetians. Then in the 15th century CE the city was taken by the Ottoman Empire. At the same time, the Bayrampasa River, the Lykos slowly filled in the Harbour with sediments and waste from the city until it became useless for the large commercial fleet in the late 12th century CE (Kadir Eriş *et al.* 2009). Princess Anna Comnena (1083-1153), a Byzantine historian, wrote "Time in its irresistible and ceaseless flow carries along on its flood all created things and drowns them in the depths of obscurity". One must wonder whether her words were inspired by the Lykos River and the slow burial of a once bustling and magnificent harbour. The remains of the time were buried in the mud, preserved and forgotten until the government of Istanbul decided to build a metro line through the location in 2004.

3. Description of BFT remains

In total some 150 large BFT vertebrae have been unearthed in Yenikapi and are carefully archived at the University of Istanbul (**Figure 2**). The origin of the bones is likely to be the immediate area, since BFT were likely abundant at the time. The butcher marks found on some bones suggest that processing of the fish likely happened within the harbour itself (**Figure 3**). After the meat was removed from the bone, it was likely sold fresh to a local buyer or preserved in salt or processed into *garum* (fermented fish sauce) and traded abroad. Since a viable population of BFT has been absent from the Black Sea since the mid 1980s (Karakulak and Oray 2009), these vertebrae are of particular interest for the scientific community. The cause of their disappearance from the Black Sea remains unknown; however, hypotheses abound, including eutrophication, noise pollution, lack of prey and changing environmental conditions.

There is a strong possibility that the BFT of the Black Sea were spawning in isolation, since their migratory movements were likely determined by the whereabouts of their prey which migrated into the warming waters of the Black Sea in the spring, returning to the warmer waters of the Mediterranean Sea in autumn. Aristotle recorded this migratory behaviour in 350 BCE and his observations have been verified by 20th century marine scientists (Akyuz and Artuz 1957; Mather *et al.* 1995, Karakulak and Oray 2009). This would place them in the Black Sea during the spawning season, far from all other spawning groups. If spawning was taking place in the Black Sea, then adaptations to the local hydrographic conditions would have been required. During the spawning season, salinity, density and temperature are lower in the Black Sea than all other BFT spawning areas (Mackenzie and Mariani 2012). Unless physical adaptations provided increased egg buoyancy (increased size, higher water content, decreased dry weight and thinner chorions with fewer lammellae), the eggs of BFT would quickly sink into the Black Sea's hypoxic waters below 100m (Mackenzie and Mariani 2012). Additional adaptations would have been required of the sperm, unfertilized eggs and developing embryo and larvae. The genetic programming for these adaptations is recorded in the bones uncovered at Yenikapi and might still be traced to the remaining descendants of this isolated tribe, if any have survived. Information concerning the distribution of the remaining Black Sea BFT can provide information about population structuring, migratory behaviour, genetic diversity and adaptive potential. By comparing the genetic code of modern and ancient BFT we can shed light on the evolution of the species genome in response to nearly two millennia of fisheries pressure, a changing climate and pollution of the sea. The rapid inundation of the harbour with fine silts has preserved all vertebrae in excellent condition. Growth rings can be easily counted and growth rates estimated with ease. DNA has already been extracted from 5 samples using unpublished molecular techniques, yielding a relatively high concentration of genetic material. As expected, the DNA is much fragmented; however, using newly developed primers we have been able to amplify short fragments of DNA (mini-barcodes) via polymerase chain reactions (PCR). Similar to the process by which archaeologists are rebuilding the unearthed galleys of Constantinople, so too, can the genetic code of ancient BFT be reassembled. In this way, we can recover a chapter in the tale of the Black Sea BFT and their relationship with the people with whom they share an intimate past. A final explanation must be given for their disappearance from the region, in order to avoid future BFT fishery collapse elsewhere. Certainly BFT have played an important historical role in the development of Istanbul and its people, who are likely to lament their absence for generations as illustrated by the sentiments of Turkish poet, Bedri Rahmi Eyüboğlu (1913-1975):

“Say İstanbul and I think of
A colossal fishing weir
One stretch a rust-colored web
Pulled tight at Beykoz
Another sagging at Fenerbahçe
Forty blue tuna in the weir
Wheeling like forty millstones
When you say blue tuna you mean
Blue tuna the king of fish
Shot through the eye with a Mauser
Sea-fans uprooted in the sea
The weir a bowl of blood now
The glass-green water turbid
In the blink of an eye forty blue tuna.”

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Figure 1. Marmaray project archeological excavations at Yenikapı (Buket *et al.* 2009).



Figure 2. Bluefin tuna vertebrae unearthed at Yenikapı in the archive (left) or on display at the University of Istanbul.

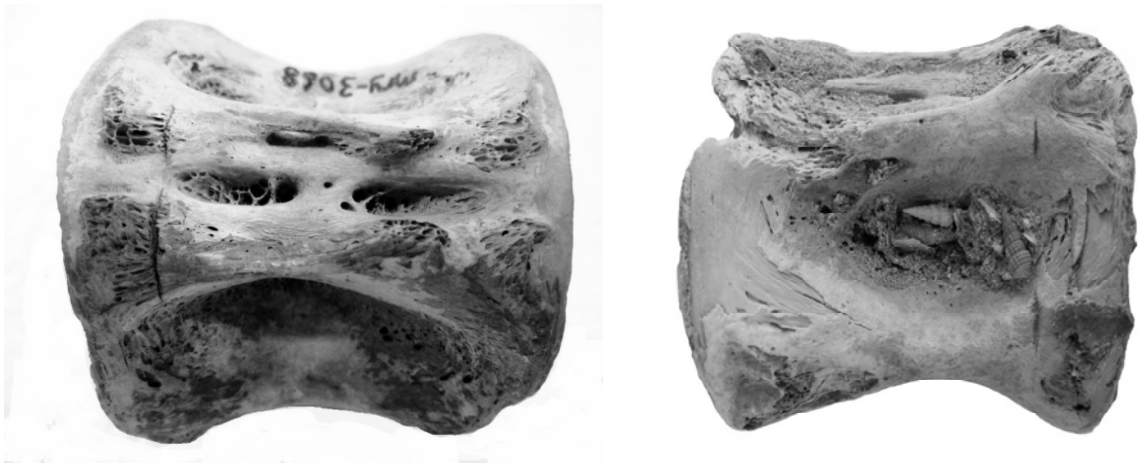


Figure 3. Left, *Thunnus thynnus* vertebrae showing butchery marks. Right, vertebrae found closer to the shoreline encrusted with gastropod shells and showing evidence of butchery.