

23rd ICAZ Fish Remains Working Group

September 28 to October 3, 2026, Nice (France)



Abstract Book



UNIVERSITÉ
CÔTE D'AZUR





23rd ICAZ Fish Remains Working Group

September 28 to October 3, 2026, Nice (France)

Organizing Team

Tatiana Theodoropoulou (Université Nice Côte d'Azur, CNRS, UMR7264 CEPAM)

Aurélia Borvon (UMR 7041 ArScAn Nanterre, France; Anatomie Comparée, Oniris VetAgroBio Nantes, France)

Aymeric Vignier (Université Nice Côte d'Azur, CNRS, UMR7264 CEPAM)

Audrey Marguin (Department of Integrative Marine Ecology (EMI), Genoa Marine Centre (GMC), Stazione Zoologica Anton Dohrn - National Institute of Marine Biology, Ecology and Biotechnology, Villa del Principe, Genoa, Italy)

Gabriele Carenti (Service d'Archéologie Métropole Nice Côte d'Azur)

Contact: frwg.nice2026@univ-cotedazur.fr

The Fish Remains Working Group (FRWG) of the International Council for Archaeozoology (ICAZ) will hold its 23rd Meeting from September 28th to October 3rd in Nice, hosted by the CEPAM laboratory (CNRS). The members of the Fish Remains Working Group form an interdisciplinary consortium of researchers (archaeozoologists, archaeologists, zoologists, ichthyologists, historians, and fisheries biologists) interested in the study of fish remains found at archaeological sites worldwide. The meeting will showcase the diversity of approaches, geographical areas, chronological periods, and themes, from the historical fluctuations of aquatic ecosystems to the diverse ways humans have exploited marine and freshwater environments through time. Fishing, fish farming, and the trade of fresh or preserved fish are just a few examples of economic activities centered on this essential resource. Furthermore, fish consumption may have had symbolic or religious significance in many cultures around the world. A particular focus will be placed on the historical dynamics of fisheries resources and the ecological impacts of fishing at various scales.

About ICAZ and the FRWG

The International Council for Archaeozoology (ICAZ) is a nonprofit organization devoted to promoting archaeozoological research of the highest scientific standards and fostering communication among the international community of archaeozoologists. ICAZ members number more than 550 individuals from 62 countries, all with the common interest of understanding past relationships between humans and animals. (from the ICAZ Website)

The Fish Remains Working Group (FRWG) was created during an informal meeting held at the Zoological Museum of the University of Copenhagen in 1980, and the second, official meeting was organised by Jean Desse in 1983 at Sophia-Antipolis (CNRS, France). Its members are an interdisciplinary consortium of researchers (archaeozoologists, archaeologists, zoologists, ichthyologists, historians, and fishery biologists) interested not only in the study of fish remains retrieved in archaeological sites from around the world, but also on any matter dealing with fishing, the fish trade, and fish consumption in prehistoric and historic times. (from the FRWG Website)

About the FRWG Nice 2026 logo

The FRWG Nice 2026 logo is inspired by the name of the bay of Nice, called « Baie des Anges » (Bay of Angels). According to local history, the local fishermen gave this name to the bay, in relation to the angelsharks brought back in their nets. Francis Gag (1900-1988), a writer from Nice, documented a recurring tradition involving local fishermen and a species of shark. In this tradition, fishermen would transport a shark on a cart. This shark, referred to as “lu pei ange” (angel fish), was showcased by a fisherman’s wife who would exclaim, “Venés, vèire la marrida bestiassa que desstrugue lu aret dòu paure pescadou!” (Come, come and see the bad beast that destroys the poor fisherman’s nets!). The sharks in question are identified as smooth back angelshark. (Gag F., Arnulf F. 1985, *Nice au fil des jours et des saisons*; Fredj G. Meinardi M. 2007, *L’ange & l’orchidée: Risso, Vèrany & Barla : une lignée de savants de renommée mondiale à Nice au XIXe siècle*).

About the CEPAM and archeo-ichthyology unit

The CEPAM (Cultures et Environnements. Préhistoire, Antiquité, Moyen Âge) laboratory is a joint research unit (UMR 7264) affiliated with the French National Center for Scientific Research (CNRS) and the Université Côte d’Azur. Based in Nice, France, CEPAM is dedicated to the interdisciplinary study of past societies, their environments, and their cultural evolution from prehistory to the Middle Ages. The laboratory brings together researchers from various disciplines, including archaeology, anthropology, geosciences, and bioarchaeology, to explore the interactions between humans and their environments over time.

Within CEPAM, the archaeo-ichthyology unit stands out as a pioneering center for the study of ancient fish remains. Founded by Jean Desse, later joined by Nathalie Desse-Berset, this unit has become a reference in the field of zooarchaeology, specializing in the analysis of fish bones from archaeological sites. Their work, spanning from the Western Atlantic and Mediterranean Europe to the Middle East and South Asia, has significantly advanced our understanding of past fishing practices, diet, and contributed to broader research on ancient economies, trade, and human-environment interactions. The unit is renowned for its fish-

bone comparative collection, one of the most extensive in Europe, which serves as an essential reference for identifying and interpreting fish remains from archaeological contexts. This collection, meticulously curated over decades, includes more than 1600 specimens from the Mediterranean, Atlantic, Indian and Pacific Oceans, as well as freshwater species from Europe, Asia and Africa, enabling precise taxonomic identifications.

The FRWG Meeting comes back to the Côte d'Azur for the third time, after the 2nd Meeting organised by Jean Dese in 1983 in Sophia-Antipolis (published in 1984) and the 14th Meeting held in 2007 in Antibes in honor of Jean Dese and Nathalie Dese-Berset (published in 2007).

Welcome to Nice

Famous for its stunning Belle Époque architecture, Nice is one of the most vibrant and captivating cities in the South of France. Bathed in sunshine and nestled along the Medi-

terranean coast, this cosmopolitan destination beautifully blends French elegance with Italian charm. For over two centuries, visitors have been drawn to Nice for its breathtaking seafront, rich culture, and relaxed lifestyle.

Stretching along the iconic curve of the Bay of Angels, the city invites you to stroll beneath swaying palm trees, admire its colourful façades, and soak up the lively atmosphere. From world-class museums and art galleries to chic boutiques, gourmet restaurants, and charming cafés, every corner of Nice offers something to discover and enjoy.

Just beyond the city, rolling hills rise gently toward the Alps, offering spectacular views and a refreshing escape into nature, less than 50 kilometres away. Perched between the Port of Nice and the Bay of Villefranche, Cap de Nice is an exclusive and peaceful area dotted with elegant villas and lush greenery. Nearby, Mont Boron National Park provides scenic walking trails, panoramic viewpoints, and a historic hilltop fort, perfect for those seeking both relaxation and adventure.

Supporting Partners



European Research Council
Established by the European Commission





Conference Program

- MONDAY, SEPTEMBER 28, 2026 -

Château de Valrose, 28 Av. Valrose, 06000 Nice

LUNCH

10:00 Venue and Welcome

Session 1: Environmental reconstruction and human-environment interaction

- 11:20 **Mark Rose**
Late Epigravettian through Early Neolithic fishing at Franchthi Cave
- 11:40 **Yvon Dréano, Henri Gandois, Nicolas Clément, Yvan Pailler, Stephan Pierre**
Below the water surface: halieutic exploitation and technical systems in the Iroise sea from the Neolithic to the Bronze Age
- 12:00 **Noemi Dipino, Rossella Duches, Nicola Nannini, Elisabetta Flor, Annaluisa Pedrotti, Federica Fontana, Ursula Thun Hohenstein, Beatrice Saletti, Alex Fontana**
The Adige River's Legacy: a long-term perspective on fish biodiversity and human activity in the Adige Valley (Trentino, Italy)
- 12:20 **Miguel Rodrigues, Sónia Gabriel**
Fish exploitation at phoenician Quinta do Almaraz: preliminary ichthyoarchaeological evidence from the K31 moat deposit
- 12:40 **Tarek Oueslati, Mohamed Kbiri Alaoui, Abdelfattah Ichkhakh, Laurent Callegarin, Claire-Anne de Chazelles, Elsa Rocca, Charlotte Carrato**
Fish consumption and aquatic resource exploitation at Rirha (Morocco) during Antiquity and medieval times

- 14:40 **Tatiana André**
Between sea, lagoon and river: reconstructing medieval fishing strategies through fish remains in Provence
- 15:00 **Sónia Gabriel, Ana Maria Costa, Sara Simões, Rui Gomes Coelho**
Fish exploitation in an early modern Atlantic trading settlement: preliminary zooarchaeological results from Cacheu 1 (Guinea-Bissau)
- 15:20 **Radovan Kabatiar**
The wandering river and fish exploitation at Kinet Höyük (Türkiye)

COFFEE BREAK

Special Opening Session: Tribute to Women and Men Pioniers in Archaeoichthyology

- 16:20 **Tatiana Theodoropoulou**
« La pêche est au bout du jardin »: the work of Nathalie Desse-Berset in the early years of archaeo-ichthyology
- 16:40 **Arturo Morales-Muñiz, Leif Jonsson, Irit Zohar**
To the memory of Knud Rosenlund and Richard Cooke
- 17:00 **Nathalie Desse-Berset**
Haddrah et gargour [images animées]: pêche traditionnelle à Bahrein (CNRS audiovisuel, 1994)

- TUESDAY, SEPTEMBER 29, 2026 -

Château de Valrose, 28 Av. Valrose, 06000 Nice

Session 1: Environmental reconstruction and human-environment interaction

- 09:00 **Sandrine Grouard, Catalina Zorro Lujan C., Mariela Declet-Perez, Carla Carvalho**
Caribaró Project: fish, human societies and long-term marine resource use in the Bocas del Toro Archipelago (Caribbean Panama)
- 09:20 **Sophia Perdikaris, Sandrine Grouard, Anaëlle Jaillon, Hefeng Hu, Léo Sabatier**
Between reef and lagoon: pre-Columbian marine resource use at Indian Town Trail, Barbuda.
- 09:40 **Younes Naime, Carola Flores, Francesco Genchi, Alfredo Coppa, Emanuela Cristiani**
Reef Fisheries and Coastal Resource Use in the Archaic Caribbean: Zooarchaeological Evidence from El Pozito (Dominican Republic)



- 10:00 **Sergio Andrés Castro Méndez**
Fish remains as indicators of human mobility in the Isthmo-Colombian area
- 10:20 **Urszula Iwaszczuk, Aurélia Borvon**
Fishing in the Red Sea. Changing strategies, various fishing grounds or environmental changes?

COFFEE BREAK

Session 2: Anthropogenic impact on marine environments

- 11:20 **Sarah Mathilde Salomé Beauvais, Emna Ben Lamine, Tatiana Theodoropoulou, Gabriele Carenti, Guillaume Leduc, Virginie Raybaud**
Past distributions of exploited teleost fishes: an ecological baseline for interpreting archaeo-fisheries
- 11:40 **Hayden A. Bernard, Ryan Kennedy, Eric Guriy, Paul Szpak**
Leveraging regional-scale archaeological fish data to explore multi-century historical fisheries from the Chesapeake Bay area
- 12:00 **Audrey Marguin, Francesca Rossi, Laury Açaf, Aymeric Vignier, Matthew McCarthy, Tatiana Theodoropoulou**
Archaeological fishes and bivalves reveal long-term ecosystem change in a Mediterranean coastal lagoon through compound-specific amino acid isotope analysis
- 12:20 **David Orton, Jen Harland, Mik Lisowski, Rowan McLaughlin**
Synthesis of Atlantic cod (*Gadus morhua*) and saithe (*Pollachius virens*) size-at-catch data from northern Scotland indicates limited impact of pre-industrial fisheries
- 12:40 **J. Ryan Kennedy**
Towards an archaeology of acclimatization societies and 19th-century animal introductions

LUNCH

- 14:40 **Gonçalo Espregueira Themudo, Inês M. dos Santos, Rebecca L.S.T. Netels, Adolfo Fernández, Sónia Gabriel, Carlos Fernández-Rodríguez, Yvon Dréano, Brice Ephrem, Gaël Piquès, Arnau Brosa-Planella, Aurélia Borvon, Irit Zohar, Gloria González Fortes, Rute R. da Fonseca, Paula F. Campos**
Reconstructing population dynamics of the European sardine (*Sardina pilchardus*) using palaeo-economics

- 15:00 **Hiroyasu Kimizuka**
The marine ecosystem from the perspective of the sardine fishery on the French Atlantic coast during the eighteenth century

Session 3: Fishing practices, processings and trades

- 15:20 **Jen Harland, Niklas Hausmann, Harry Robson, Stephanie Piper, Holly Young**
Oronsay Revisited: first results from new excavations at the Mesolithic shell midden site of Cnoc Coig, Scotland
- 15:40 **Aymeric Vignier, Gabriele Carenti, Tatiana Theodoropoulou**
Small Fish, Big Questions: explaining fish size during the Mesolithic-Neolithic transition in the Mediterranean

COFFEE BREAK

- 16:40 **Albane Mazet**
Bone hooks and fish remains: an integrated study of prehistoric fishing practices in Norway
- 17:00 **Vito Giuseppe Prillo, Marco Baioni, Andrea De Martino, Valeria Sarnico, Massimo Vidale**
Sieving for bones: freshwater fish exploitation in the Po Plain during the Bronze Age
- 17:20 **Syrielle Fayet, Konrad Smiarowski**
Coastal subsistence in Bronze Age and Iron Age Norway: specialized fishing settlement at Selje

- WEDNESDAY, SEPTEMBER 30, 2026 -

- 9:00 **In-town excursion** (Place de l'Île de Beauté, 06000 Nice). Visit to Lazaret cave. Discussion with local fisherman and visit of traditional boat (lou passagin). Visit to Natural History Museum.

- 13:00 **Maison des Sciences de l'Homme et de la Société Sud-Est**, 25 Av. François Mitterrand, 06300 Nice

LUNCH



Poster Session

14:30 - 16:00

Luis Roberto Miranda Muñoz

Paleoclimatic factors and variability of consumption of ichthyological species during the Early Formative (1800 – 1500 BCE.) In Vichama, Huara Valley, Peru

Katrien Dierickx, Jessica Hendy, Christophe Snoeck

Flanders's Riverine Exploitation and ecoSystems throughout History - FRESH: an intro

Albane Mazet, Gabriele Carenti, Tatiana Theodoropoulou

Fishing equipment in the Mediterranean from pre-history to Antiquity: current knowledge, technological developments and research gaps

Barbara Wilkens

The importance of fish diet in Santa Maria di Tergu in northern Sardinia

Arnau Brosa-Planella, Laura Llorente, Maria Saña Seguí, Santiago Riera Mora, Arturo Morales Muñoz, Krista McGrath, André C. Colomese

Unravelling the role of Atlantic fish in medieval and early modern Western Mediterranean foodways

Elise Dufour, Benoit Clavel

Fish and military rations during the reign of Louis XIV: an archaeozoological and Isotopic analysis of cod remains from Fort Saint-Sébastien (France)

Irit Zohar, Ámbar Martínez-Madrid, Eufrosia Roselló-Izquierdo, Laura Llorente Rodríguez, Sonia Pinsky, Ron Beeri, Ayelet Gilboa, Golan Shalvi, Arturo Morales-Muñiz

A tale of two coastal sites: taxonomy and taphonomy

Suzanne Needs-Howarth, Max Friesen

Minimizing bias during an analysis of fish remains from Kuukpak, an ancestral Inuvialuit site in the Mackenzie Delta, Canada

Rebecca L.S.T. Netels, Sónia Gabriel, Carlos Fernández-Rodríguez, Gloria González-Fortes, Rute R. da Fonseca, Paula F. Campos

The origin and evolution of hake (*Merluccius merluccius*, Linnaeus 1858) exploitation in Iberia, a paleogenomic approach

16:30 Visit of the CEPAM and fishbone reference collections

19:00 **Conference Banquet.** Hotel Le Saint Paul, 29 Bd. Franck Pilatte, 06300 Nice

- THURSDAY, OCTOBER 1, 2026 -

Château de Valrose, 28 Av. Valrose, 06000 Nice

Session 3: Fishing practices, processings and trades

09:00 Simone Häberle

A 1st century AD amphora filled with fish: the discovery of roman sardines in Gebenstorf, Switzerland

09:20 Ashley Marshall, Gaël Piquès, Iouri Bermond, Delphine Lopez, Corinne Sanchez,

Fish consumption at Marinesque roadside relay station in the 1st Century BCE

09:40 Alfred Galik

Seafood from the Domitian's square in Ephesos

10:00 Kata Szathmári

Medieval bone fishing net weights from Hungary

10:20 Wim Wouters, Jan Huyghe, Mathijs Speecke, An Lentacker, Anton Eryvynck

A cod (*Gadus morhua*) festival in late medieval Bruges (Belgium)

COFFEE BREAK

11:20 Arnau Brosa-Planella, Maria Saña Seguí, Santiago Riera Mora, Arturo Morales Muñoz

The evolution of fish chain frame in the northeast of the Iberian Peninsula throughout the medieval and modern periods (7th–18th Centuries)

11:40 Diana Rocio Carvajal Contreras

Comparative analysis of Pre-Columbian fish butchering: the case of Sueños de Libertad, Colombia



Session 4: Methodological and scientific applications

12:00 Matthew Campbell, Jingjing Zhang, Armagan Sabetian

More adventures in sharkaeology: trace element analysis of the NRD shark vertebrae

12:20 Rachel M. Winter, Rikke Beckmann Dahl, Erin Dillon, Leah Rubin, Elizabeth C. Sibert

Unravelling the cause of much chagrin: results of dermal denticle morphology on marine shagreen for insights into historic elasmobranch exploitation

12:40 Gabriela Prestes Carneiro

Ichthyoarchaeological reference collections and their contemporary challenges

LUNCH

14:40 Miguel Rodrigues, Diogo Dias, Diogo Ribeiro, Mafalda Moncada, Beatriz Castro, Filipe Ribeiro, Sónia Gabriel

Some bones to pick: towards osteological differentiation in four portuguese Mugilid species and size estimation regressions for *Chelon ramada*

15:00 Laura Llorente Rodríguez, Anouk van de Ven, Irit Zohar, Ámbar Martínez-Madrid, Eufrosia Roselló-Izquierdo, Guy Sisma-Ventura, Arturo Morales-Muñiz,

The Dentine Time Capsule: investigating human-marine interactions through stable isotope analysis of gilthead seabream (*Sparus aurata*) dentine and bone collagen

15:20 Irit Zohar, Arturo Morales-Muñiz, Jens Najorka

Hidden in the enamel: the contribution of X-Ray Diffraction methodology in understanding fish processing methods

16:00 Closing Remarks and venue of the next FRWG Meeting



Program timetable

	Monday 28/09/26	Tuesday 29/09/26	Wednesday 30/09/26	Thursday 01/10/26	Friday 02/10/26	Saturday 03/10/26
9:00						
9:20						
9:40		Session ①		Session ③		
10:00	Venue and Welcome					
10:20						
10:40		coffee break		coffee break		
11:00						
11:20				Session ③		
11:40						
12:00	Session ①	Session ②		Session ④		
12:20						
12:40						
13:00	Lunch					
13:20						
13:40						
14:00						
14:20						
14:40	Session ①	Session ②		Session ④	Post-conf. excursion	Post-conf. excursion
15:00						
15:20		Session ③				
15:40	coffee break			coffee break		
16:00		coffee break				
16:20						
16:40		Session ③				
17:00	Special Opening Session			Closing remarks FRWG congress		
17:20						
17:40						
18:00						
18:20						
18:40						
19:00						
19:20	Opening cocktail diner			Farewell drinks		
19:40						
20:00						
20:20						
20:40						
21:00						

Sessions

- ① Environmental reconstruction and human-environment interaction
- ② Anthropogenic impact on marine environments
- ③ Fishing practices, processings and trades
- ④ Methodological and scientific applications



Théâtre du Grand Château, Valrose Campus

28 Av. Valrose, 06000 Nice

Monday 28/09/26	
9:00	
9:20	
9:40	
10:00	Venue and Welcome
10:20	
10:40	
11:00	
11:20	Session 1
11:40	
12:00	
12:20	
12:40	Lunch
13:00	
13:20	
13:40	
14:00	Session 1
14:20	
14:40	
15:00	
15:20	coffee break
15:40	
16:00	Special Opening Session
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17:20	Opening cocktail diner
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Environmental reconstruction and human-environment interaction

M. Rose

Late Epigravettian through Early Neolithic fishing at Franchthi Cave

Y. Dréano *et alii*

Below the water surface: Halieutic exploitation and technical systems in the Iroise sea from the Neolithic to the Bronze Age

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The Adige River's Legacy: a long-term perspective on fish biodiversity and human activity in the Adige Valley (Trentino, Italy)

M. Rodrigues, S. Gabriel

Fish exploitation at phoenician Quinta do Almaraz: preliminary ichthyoarchaeological evidence from the K31 Moat deposit

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Fish consumption and aquatic resource exploitation at Rirha (Morocco) during Antiquity and medieval times

Environmental reconstruction and human-environment interaction

T. André

Between sea, lagoon and river: reconstructing medieval fishing strategies through fish remains in Provence

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Fish exploitation in an early modern Atlantic trading settlement: preliminary zooarchaeological results from Cacheu 1 (Guinea-Bissau)

R. Kabatlar

The wandering river and fish exploitation at Kinet Höyük (Türkiye)

Tribute to women and men pioneers in Archeoichthyology

T. Theodoropoulou

« La pêche est au bout du jardin »: the contribution of Nathalie Desse-Berset in the formative years of archaeo-ichthyology

A. Morales-Muñoz *et alii*

To the memory of Knud Rosenlund and Richard Cooke

N. Desse-Berset

Haddrah et gargour [images animées]: pêche traditionnelle à Bahrein (CNRS audiovisuel, 1994)



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	Tuesday 29/09/26
9:00	Session 1
9:20	
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10:20	coffee break
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11:40	Session 2
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13:00	Lunch
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13:40	
14:00	
14:20	Session 2
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15:00	
15:20	
15:40	Session 3
16:00	
16:20	
16:40	
17:00	Session 3
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17:40	
17:40	

Environmental reconstruction and human-environment interaction

S. Grouard *et alii*

Caribaró Project: fish, human societies and long-term marine resource use in the Bocas del Toro Archipelago (Caribbean Panama)

S. Perdikaris *et alii*

Between reef and lagoon: pre-Columbian marine resource use at Indian Town Trail, Barbuda.

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Reef fisheries and coastal resource use in the Archaic Caribbean: zooarchaeological evidence from El Pozito (Dominican Republic)

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Fish remains as indicators of human mobility in the Isthmo-Colombian area

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Anthropogenic impact on marine environments

S.M.S. Beauvais *et alii*

Past distributions of exploited teleost fishes: an ecological baseline for interpreting archaeo-fisheries

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Towards an archaeology of acclimatization societies and 19th-century animal introductions

Fishing practices, processings and trades

J. Harland *et alii*

Oronsay Revisited: first results from new excavations at the Mesolithic shell midden site of Cnoc Coig, Scotland

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Reconstructing population dynamics of the European sardine (*Sardina pilchardus*) using palaeogenomics

H. Kimizuka

The marine ecosystem from the perspective of the sardine fishery on the French Atlantic coast during the eighteenth century

Fishing practices, processings and trades

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Bone hooks and fish remains: an integrated study of prehistoric fishing practices in Norway

V.G. Prillo *et alii*

Sieving for bones: freshwater fish exploitation in the Po Plain during the Bronze Age

S. Fayet, K. Smiarowski

Coastal subsistence in Bronze Age and Iron Age Norway: specialized fishing settlement at Selje



**Maison des Sciences de
l'Homme et de la Société
Sud-Est (CEPAM lab)**

25 Av. François Mitterrand, 06300 Nice

Wednesday 30/09/26	
9:00	in-town excursion
9:20	
9:40	
10:00	
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13:00	Lunch
13:20	
13:40	Poster session
14:00	
14:20	
14:40	
15:00	
15:20	
15:40	
16:00	
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17:00	
17:20	Conference banquet
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20:40	
21:00	

Hôtel Le Saint Paul

29 Bd. Franck Pilatte, 06300 Nice

- Lazaret cave
- Discussion with local fisherman and visit of traditional boat (lou passagin)
- Natural History Museum

Anthropogenic impact on marine environments

K. Dierickx *et alii*

Flanders' Riverine Exploitation and ecoSystems throughout History - FRESH: an intro

Environmental reconstruction and human-environment interaction

L.R. Miranda Muñoz

Paleoclimatic factors and variability of consumption of ichthyological species during the Early Formative (1800 – 1500 BCE.) In Vichama, Huara Valley, Peru

Fishing practices, processings and trades

A. Mazet *et alii*

Fishing equipment in the Mediterranean from prehistory to Antiquity: current knowledge, technological developments and research gaps

B. Wilkens

The importance of fish diet in Santa Maria di Tergu in northern Sardinia

A. Brosa-Planella *et alii*

Unravelling the role of Atlantic fish in medieval and early modern Western Mediterranean foodways

E. Dufour, B. Clavel

Fish and military rations during the reign of Louis XIV: an archaeozoological and Isotopic analysis of cod remains from Fort Saint-Sébastien (France)

Methodological and scientific applications

I. Zohar *et alii*

A tale of two coastal sites: taxonomy and taphonomy

S. Needs-Howarth, M. Friesen

Minimizing bias during an analysis of fish remains from Kuukpak, an ancestral Inuvialuit site in the Mackenzie Delta, Canada

R.L.S.T. Netels *et alii*

The origin and evolution of hake (*Merluccius merluccius*, Linnaeus 1858) exploitation in Iberia, a paleogenomic approach



Théâtre du Grand Château, Valrose Campus

28 Av. Valrose, 06000 Nice

	Thursday 01/10/26
9:00	
9:20	
9:40	Session 3
10:00	
10:20	
10:40	coffee break
11:00	
11:20	Session 3
11:40	
12:00	
12:20	Session 4
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13:20	Lunch
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14:00	
14:20	
14:40	
15:00	Session 4
15:20	
15:40	coffee break
16:00	
16:20	
16:40	
17:00	Closing remarks FRWG congress
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21:00	

Fishing practices, processings and trades

S. Häberle

A 1st century AD amphora filled with fish: the discovery of roman sardines in Gebenstorf, Switzerland

A. Marshall *et alii*

Fish consumption at Marinesque roadside relay station in the 1st Century BCE

A. Galik

Seafood from the Domitian's square in Ephesos

K. Szathmári

Medieval bone fishing net weights from Hungary

W. Wouters *et alii*

A cod (*Gadus morhua*) festival in late medieval Bruges (Belgium)

Fishing practices, processings and trades

A. Brosa-Planella *et alii*

The evolution of fish chain frame in the northeast of the Iberian Peninsula throughout the medieval and modern periods (7th–18th Centuries)

D. Rocio Carvajal Contreras

Comparative analysis of Pre-Columbian fish butchering: the case of Sueños de Libertad, Colombia

Methodological and scientific applications

M. Campbell *et alii*

More adventures in sharkaeology: trace element analysis of the NRD shark vertebrae

R.M. Winter *et alii*

Unravelling the cause of much chagrin: results of dermal denticle morphology on marine shagreen for insights into historic elasmobranch exploitation

G. Prestes Carneiro

Ichthyoarchaeological reference collections and their contemporary challenges

Methodological and scientific applications

M. Rodrigues *et alii*

Some bones to pick: towards osteological differentiation in four portuguese Mugilid species and size estimation regressions for *Chelon ramada*

L. Llorente Rodríguez *et alii*

The Dentine Time Capsule: investigating human-marine interactions through stable isotope analysis of gilthead seabream (*Sparus aurata*) dentine and bone collagen

I. Zohar *et alii*

Hidden in the enamel: the contribution of X-Ray Diffraction methodology in understanding fish processing methods



Session 1

Environmental reconstruction and human-environment interaction

[S1.1-A] -Monday, September 28, 2026 (11:20)

Late Epigravettian through Early Neolithic fishing at Franchthi Cave

Mark Rose*

* Franchthi Cave Project

Keywords: Franchthi Cave; Upper Paleolithic; Mesolithic; Neolithic; *Thunnus*; Aegean

Abstract: Late Epigravettian through the Early Neolithic fish assemblages at Franchthi, 13000 through 6000 cal BC, are described here in the context of significant environmental (climate, sea level, and marine events) and cultural (preferences, economic strategies, and site function) changes using the recently completed Franchthi General Phasing (FGP) chronostratigraphic framework.

While modest amounts of fish, but no shellfish or snails, were consumed in the Late Epigravettian (FGP 4), the Final Epigravettian 1 (FGP 5) sees significant changes, including snail middens and, especially in the FGP 5.1 subphase, abundant fish with numerous *Sparus aurata*, other sparids, and *Dicentrarchus*, along with pond turtles (*Emys orbicularis*). In the later FGP 5.2, fish and pond turtles decline, but edible shellfish, *Patella* and *Cerithium*, appear. The evolving coast, 4 km distant in the FGP 5, likely offered a brackish lagoon or estuary near the cave and the larger groups using it as a basecamp clearly recognized such productive waters. In the Final Epigravettian 2 (FGP 6), during the YD, all remains decline, indicating less intensive occupations, but the brackish fish group were still exploited.

The cave served chiefly as a burial site in the Lower Mesolithic (FGP 7), about 8600–8250 cal BC, but three fish sub-phases show ongoing brackish catches and harbin-gers of later changes: LM F1 Mugilidae predominate, with *Anguilla* and Sparidae; LM F2 fish decline but *Anguilla* increases proportionally and a very few *Thunnus* are present; and LM F3 with *Sphyræna* abundant.

Abundant *Thunnus*, generally ~1.2 but up to 1.7 m FL, characterize the Upper Mesolithic (FGP 8) and Franchthi was occupied at least seasonally as fishing camp (Several thousand vertebrae were found in the three main trench complexes, each separated by ca. 16 m). Fish remains reach the highest density (gr/l) at Franchthi in the first subphase, FGP 8.1, but decline in FGP 8.2 when smaller coastal taxa predominate though *Thunnus* are still common.

Numerous non-geometric microliths were perhaps used in processing fish, and use-wear indicates notches and denticulates were used on reeds or wood possibly in fabrication of fishing gear or small watercraft. The coast, <2.5 km from the cave, was quite close to the modern shore along the promontories N and S of the outer modern embayment.

After a hiatus, the Final Mesolithic (FGP 9) reflects a generalized occupation. Few, if any, *Thunnus* were caught, and the UM microliths are gone with them, but Clupeidae,

Sparidae, *Sphyræna* and Mugilidae are present. The environmental setting is no different than in the FGP 8, so the *Thunnus* absence must have another explanation but the Initial Neolithic (FGP 10), arriving 6600/6500 cal BC, offers none. Sheep and goat monopolize the faunal remains and wild plants, small game, and fish are scarce if present. However, the Early Neolithic (FGP 11), a separate arrival after about 6300, with an extensive shoreline settlement, Cerastoderma bead production, and import-ed flint and of obsidian (28%) attests a prosperous community unaffected by the 8.2 ka event. And remains show fishing resumed, modestly but including the occasional catch of large *Thunnus*.

[S1.2-A] -Monday, September 28, 2026 (11:40)

Below the water surface: halieutic exploitation and technical systems in the Iroise sea from the Neolithic to the Bronze Age

Yvon Dréano (1,2); Henri Gandois (2); Nicolas Clément (3); Yvan Pailler (4); Stephan Pierre (4)

(1) Eveha – Tours; (2) CNRS, CReAAH, Université de Rennes, France; (3) UMR 8215 – Trajectoires, Univ. Paris 1 - Panthéon-Sorbonne, France; (4) UMR 6554, LETG, univ. Brest, univ. Nantes, univ. Rennes, IUEM, rue Dumont d'Urville, 29280 Plouzané, France

Keywords: Ichthyofauna; Archipelago; Fish trap (Weir); Halieutic economy; Neolithic - Bronze Age

Abstract: The Molène archipelago represents an exceptional archaeological laboratory for studying human adaptation to insularity between the 5th and 2nd millennia BCE. During the Holocene, what is now merely a string of granitic islets scattered across the Iroise Sea formed a vast continental plateau in the process of submersion. This shifting geography provided foreshores of forgotten biological richness; during the Bronze Age, these areas covered a surface three times larger than they do today. Far from being isolated, these societies successfully transformed maritime constraints into a technical and social system of remarkable resilience. Knowledge of these ways of life relies on an archaeological windfall: shell middens. Calcium carbonate from the mollusks neutralized the natural acidity of the Armorican soils, thereby preserving thousands of fish bones. Iconic sites such as Beg ar Loued, Porz ar Puns, and Mez Notariou reveal sedentary habitats where maritime predation complemented structured agro-pastoral production (barley, wheat, and caprine livestock). Archaeologists describe a hybrid economy where every resource, from grey seals to seabirds, was exploited with a perfect mastery of biological and seasonal cycles. The engineering of these populations is expressed through a veritable foreshore megalithism. Monumental fish traps —constructed from slabs



set on edge and sometimes stretching over 300 meters— allowed for the massive capture of fish according to tidal rhythms. Ichthyofaunal analysis reveals a shift in strategies: the Neolithic focus on sea bass and gilthead seabream was followed, in the Middle Bronze Age, by a diversification toward rocky-bottom species (wrasse, pollack), suggesting technical innovations such as the use of weighted lines to reach deeper areas. Ultimately, the archipelago was not an isolated margin but a strategic crossroads on the maritime routes linking Armorica to the British Isles. The rational management of surpluses, through drying or smoking, along with complex ritual practices, delineate a maritime identity forged by the ocean.

Faced with the inexorable rise in sea levels, these groups demonstrated a cultural plasticity whose history—now threatened by erosion— offers a valuable lesson in adaptation to contemporary climate challenges.

[S1.3-A] -Monday, September 28, 2026 (12:00)

The Adige River's Legacy: a long-term perspective on fish biodiversity and human activity in the Adige Valley (Trentino, Italy)

Noemi Dipino (1); Rossella Duches (1); Nicola Nannini (1); Elisabetta Flor (1); Annaluisa Pedrotti (2); Federica Fontana (3); Ursula Thun Hohenstein (3); Beatrice Saletti (3); Alex Fontana (1)

(1) MUSE - Science Museum of Trento, Research and Museum Collections Office, Trento, Italy; (2) University of Trento, Department of Humanities, Trento, Italy; (3) University of Ferrara, Department of Humanities, Section of Prehistoric and Anthropological Sciences, Ferrara, Italy

Keywords: Mesolithic; Adige Valley; Italy; fish remains; biodiversity;

Abstract: The Adige Valley is one of the most dynamic landscapes of the Alpine region, where nature and human presence are inextricably intertwined. Ever since its Holocene repopulation following the Last Glacial Maximum, the valley has had the role of the primary artery connecting peninsular Italy with Central Europe.

Throughout its history as a crucial natural and cultural corridor, the valley has undergone intense transformations driven by human activity. At the base of this evolution is the Adige River— one of the valley's defining element and the primary engine of its environmental and social evolution.

Since ancient times, the river has represented a crucial lifeline for the valley, offering abundant natural resources — primarily fish — that sustained the valley's earliest communities.

In more recent times, however, the river's ecological and subsistence functions were followed by the exploitation of its waters for hydroelectric power, flood control and agriculture.

Large-scale interventions designed to use the river's power began to dominate the landscape, altering its natural dynamics and impacting native fish populations.

Within this general framework, our research aimed to re-

construct the interactions between human communities and the river's complex ecological mosaic that has characterized the Adige Valley since the Mesolithic period, focusing in particular on fish populations. This was achieved through the study of the ichthyofaunal assemblages from three multi-layered archaeological sites located near Trento (Riparo Pradestel, Riparo Gaban and Riparo Romagnano Loc III), combined with the analysis of historical documentation related to these environmental and socio-economic dynamics. The ultimate goal was to reconstruct 10,000 years of history, ranging from Mesolithic fishing techniques to 20th-century fish farms, and from subsistence fishing to medieval ritual consumption.

The interdisciplinary perspective of this work was essential to better understand the present-day dynamics and challenges related to river ecosystems and their resources. By combining archaeological, historical and ecological perspectives, this research aimed to interpret past and present patterns of resource exploitation while also providing insights for addressing current environmental issues, helping to find a balance between resource exploitation, protection, and the sustainable management of fisheries.

[S1.4-A] -Monday, September 28, 2026 (12:20)

Fish exploitation at phoenician Quinta do Almaraz: preliminary ichthyoarchaeological evidence from the K31 moat deposit

Miguel Rodrigues (1); Sónia Gabriel (2)

(1) UNIARQ - Centre for Archaeology of the University of Lisbon; (2) CEAU-FAUP, Centre for Studies in Urbanism and Architecture, Faculty of Architecture, University of Porto

Keywords: Portugal; Iron Age; Tagus estuary; Osteological analysis; Estuarine & Marine resources

Abstract: Quinta do Almaraz is an archaeological site located in Almada, Portugal, at the confluence of the Tagus estuary and the Atlantic Ocean. Although evidence of Chalcolithic, Bronze Age, and Roman occupation has been identified, the best-preserved stratigraphic sequence dates to the 1st millennium BC. and reveals a strong Phoenician presence.

The fish remains analysed in this study derive from excavations carried out between 1994 and 2001 in different areas of the site, including an habitation area (square D20) and a ditch/moat (squares K31, J27/4, J28/2, A12/B12) subsequently filled with domestic waste. This paper presents the preliminary results of the ichthyoarchaeological analysis of the assemblage recovered from square K31, which revealed a highly diverse fish spectrum comprising nearly 50 identified taxa.

Sardine (*Sardina pilchardus*) is the most abundant species, followed by picarel (*Spicara smaris*), Atlantic horse mackerel (*Trachurus trachurus*), gilthead seabream (*Sparus aurata*) and Mediterranean moray (*Muraena helena*). At the family level, Sparidae is the best represented group, followed by Mugilidae, Alosidae, Carangidae and Muraenidae.



The comparison of these results with other Phoenician sites from both the Atlantic and Mediterranean, such as Castillo de Doña Blanca, Toscanos (Spain), Lixus, Mogador (Morocco) and Sant'Antioco (Italy), reveals a shared pattern of resource exploitation in the strong presence of Sparidae (both at the family and species level) and Mugilidae, which appear consistent across these Phoenician archaeological sites, and a distinctive pattern of resource exploitation in which Quinta do Almaraz differs evidently because of the predominance of sardine and near absence of meagre (*Argyrosomus regius*), contrasting with the patterns of the above mentioned sites.

These results suggest a common dietary preference along the different sites, while also pointing to local adaptations to the environmental conditions and resource availability of the Tagus estuary and the Portuguese Atlantic coast. Thus, this assemblage provides valuable new data for understanding subsistence strategies, economic practices, and cultural interactions within Phoenician networks in Western Iberian Peninsula.

[S1.5-A] -Monday, September 28, 2026 (12:40)

Fish consumption and aquatic resource exploitation at Rirha (Morocco) during Antiquity and medieval times

Tarek Oueslati (1); Mohamed Kbiri Alaoui (2); Abdelfattah Ichkhakh † (3); Laurent Callegarin (4); Claire-Anne de Chazelles (5); Elsa Rocca (5); Charlotte Carrato (6)

(1) CNRS UMR9028 HARTIS; (2) Université de Lille IN-SAP, Rabat; (3) Inspection des monuments historiques et des sites, Essaouira; (4) Université de Pau, IRAA UAR 3155 CNRS; (5) Université Paul Valéry, CNRS UMR5140 ASM; (6) Mosaïques Archéologie, UMR5140 ASM

Keywords: Ichthyoarchaeology; Aquatic resource exploitation; Freshwater fisheries; Rirha (Morocco); Fish consumption patterns

Abstract: Located in the Gharb plain of Morocco, the archaeological site of Rirha was occupied over a long period, from the Mauretanian period (5th century BC) to the medieval period. Situated inland, nearly 100 kilometres from the Atlantic coast, the site provides an opportunity to investigate the exploitation and supply of aquatic resources by ancient populations.

The ichthyoarchaeological study of the remains from the different occupation phases reveals a strong reliance on freshwater and migratory fish species. The identified assemblages show a clear predominance of the Barbini lineage (*Luciobarbus* sp, *Carasobarbus* sp, *Pterocapoeta maroccana*), shads (*Alosa* sp.), with occasional remains of eels (*Anguilla* sp.) and mullets (Mugilidae). This composition suggests that fish consumption at Rirha was mainly based on resources available in the nearby Beht River. The exploitation of estuarine environments remains uncertain due to the absence of associated species typically linked with shad.

In fact, marine fish are extremely rare in the assemblage: a single seabass (*Dicentrarchus labrax*) maxilla, recovered

from a Roman-period context, represents the only evidence of a strictly marine species. This scarcity raises questions about fishing practices, supply networks, and the status of aquatic products consumed at Rirha, highlighting the importance of locally available resources compared with possible imports from the coast, which are documented through the presence of imported dead marine shells, probably used as ornaments or as raw material for mother-of-pearl objects.

This contribution aims to shed light on fish consumption patterns and aquatic resource exploitation at Rirha, providing new insights into the role of fish in the subsistence economy of an inland diachronic settlement of Morocco.

[S1.6-B] -Monday, September 28, 2026 (14:40)

Between sea, lagoon and river: reconstructing medieval fishing strategies through fish remains in Provence

Tatiana André*

* Aix Marseille Univ, CNRS, LA3M, Aix-en-Provence, France

Keywords: Medieval Provence; archaeoichthyology; fisheries; aquatic environments; lagoonal ecosystems

Abstract: This paper presents the results of a recently completed doctoral thesis (2026) focusing on fishing practices and fish consumption in medieval Provence (8th–15th centuries), combining archaeology, archaeoichthyology, and historical sources. The study is based on a corpus of four sites —Fos-sur-Mer, Hyères, Marignane, and Aix-en-Provence— covering a range of environmental and socio-economic contexts, from coastal and lagoonal settings to inland urban areas.

The analysis relies on several thousand fish remains, identified and quantified through standard archaeozoological methods, alongside an ecological classification of taxa according to their habitats (marine, lagoonal, brackish, freshwater, and migratory species). This approach enables a refined reconstruction of exploited environments and fishing strategies, with particular attention to transitional ecosystems such as lagoons and coastal wetlands.

Results highlight the central role of local resource exploitation and the complementary use of multiple aquatic environments.

Lagoonal and coastal species are strongly represented across all sites, indicating the importance of nearshore fishing, while marine taxa suggest additional connections to offshore zones.

Freshwater and migratory species further illustrate the diversity of exploited ecosystems and the flexibility of procurement strategies.

Despite differences in site function and status, fish consumption appears relatively homogeneous, pointing to shared dietary practices across social contexts. Evidence for processing and distribution remains limited but suggests primarily regional supply systems, with possible integration into broader exchange networks.

More broadly, this study proposes a model of a flexible and



adaptive regional economy, structured around proximity to aquatic resources and the integration of diverse environments. By emphasizing the role of lagoonal and transitional ecosystems —often underrepresented in archaeozoological studies— this research contributes to ongoing discussions on medieval fisheries, resource management, and human-environment interactions in the Mediterranean.

It also provides a methodological framework for integrating ecological classification into archaeoichthyological analysis, offering new perspectives for comparative studies at both regional and Mediterranean scales.

[S1.7-B] -Monday, September 28, 2026 (15:00)

Fish exploitation in an early modern Atlantic trading settlement: preliminary zooarchaeological results from Cacheu 1 (Guinea-Bissau)

Sónia Gabriel (1); Ana Maria Costa (1,2,3); Sara Simões (3); Rui Gomes Coelho (4,3)

(1) Laboratório de Arqueociências - Património Cultural, I.P.; (2) IDL – Instituto Dom Luiz – Faculdade de Ciências da Universidade de Lisboa; (3) UNIARQ-Centre for Archaeology, University of Lisbon, Portugal; (4) Department of Archaeology, Durham University, UK

Keywords: Archaeoichthyology; Upper Guinea Coast; Estuarine resources; Atlantic trade; Human–environment interactions

Abstract: Fish remains recovered from Cacheu 1 (Guinea-Bissau) provide insights into the exploitation of estuarine resources on the Upper Guinea Coast. The site forms part of the historic settlement of Cacheu, one of the main Portuguese colonial centres in West Africa, which was primarily associated with the trade of enslaved people. The analysed assemblage derives from stratified archaeological contexts associated with occupations spanning the fifteenth/sixteenth to twentieth centuries and excavated during the 2022 field season.

Zooarchaeological analyses included taxonomic and anatomical identification supported by osteological atlases and virtual reference collections. A total of 616 fish remains (NISP) were identified. The assemblage is dominated by Ariidae (catfishes), followed by Sciaenidae (croakers), Mugilidae (mullets), Cichlidae and Carangidae. These taxa are commonly associated with estuarine and coastal ecosystems. Marked differences were observed between excavation areas. While TR1 is overwhelmingly dominated by shellfish remains, particularly oysters, fish are comparatively scarce (NISP = 102; 4.4% of all identified faunal remains). In contrast, TR2 yielded a substantially larger fish assemblage (NISP = 514), representing 46.3% of all identified faunal remains and constituting the most abundant faunal category in that area. These contrasts may reflect differences in resource exploitation, consumption practices, depositional histories, or other taphonomic factors across the occupation sequence. The predominance of estuarine taxa such as Ariidae, Sciaenidae and Mugilidae is consistent with exploitation patterns documented in archaeological and ethnographic contexts

across the Senegambian region, where fishing and shellfish gathering have long formed important components of subsistence strategies associated with estuarine and mangrove environments. The Cacheu assemblage provides one of the few currently available zooarchaeological datasets for the study of fish exploitation in Guinea-Bissau and contributes to a better understanding of human - environment interactions along the Upper Guinea Coast.

[S1.8-B] -Monday, September 28, 2026 (15:20)

The wandering river and fish exploitation at Kinet Höyük (Türkiye).

Radovan Kabatlar*

* The Archaeology Centre, University of Toronto, St. George Campus, Toronto, Canada

Keywords: Kinet Höyük; coastal archaeology; fish bones; geomorphology; satellite imagery

Abstract: The ancient coastal site of Kinet Höyük is situated in the north-east corner of the Mediterranean, overseeing a narrow strategic coastal corridor known as the Issos Plain, which connects the Anatolian plateau with the northern Levant. The site has a long history of occupation. The currently known earliest evidence of occupation dates to the Late Neolithic (Halafian).

The site was inhabited almost without interruption from the Early Bronze II (2800 BCE) until 50 BCE when it was abandoned. It was reoccupied again in the Medieval period (late twelfth–fourteenth centuries AD).

Kinet Höyük represents the largest mound in eastern (Plain) Cilicia. It has an upper mound which rises 26 meters above the plain and covers roughly 3.3 ha. In the past, the mound had extensive lower terraces on all sides, which were mostly destroyed by modern industrial developments and extensive horticulture. Geomorphological and archaeological evidence suggest that the site was originally located on the promontory controlling two harbours – a marine harbour to the north and a second harbour in the Deli Çay river estuary to the south.

This remarkable location allowed for easy access to aquatic resources.

Although the diet of the inhabitants relied predominantly on agriculture and animal husbandry throughout its history, marine and freshwater fish and molluscs were an integral part of the food economy.

The osteo-ichthyological evidence from the upper mound indicates that the intensity of fishing did not remain constant through the different occupational periods. It further shows that marine fish were exploited to a greater extent compared to the riverine fish, which appears absent in some periods while abundant in others.

This study examines the riverine fish exploitation and the factors which could have contributed to the uneven and sometimes limited utilization of this food resource. In addition to the analysis of fish bones, the study also considers geomorphological data, historical cartography, satellite imagery, and modern hydrological studies.



[S1.9-C] -Tuesday, September 29, 2026 (09:00)

Caribará Project: fish, human societies and long-term marine resource use in the Bocas del Toro Archipelago (Caribbean Panama)

Sandrine Grouard (1); Catalina Zorro Lujan C. (1,2); Mariela Declet-Perez (1,3); Carla Carvalho (4)

(1) BioArch (UMR 7209) - Bioarchéologie, Interactions, Pratiques, Environnements - Muséum national d'Histoire naturelle; (2) Departamento de Antropología, Universidad de los Andes, Cra 1 #18A-12, 111711 Bogotá, Colombia; (3) Anthropology Department, University of California San Diego, La Jolla, California, USA; (4) Lab. AMS-C14 (LAC) - Universidade Federal Fluminense, Rio de Janeiro, Brasil

Keywords: archaeoichthyology; zooarchaeology; Bocas del Toro Panama; pre-Columbian; subsistence marine resources

Abstract: The Caribará project presents an archaeological and ethnoarchaeological investigation of the Bocas del Toro archipelago (Caribbean coast of Panama), a region long overlooked due to its remoteness and the predominance of research focused on the Pacific provinces and central Panama. This project combines archaeoichthyological and zooarchaeological inventories, excavation data, and ethnoarchaeological perspectives to reconstruct subsistence practices, human-animal relationships, and long-term settlement history across a highly diverse coastal and insular environment.

The region's archaeological potential was first revealed between 1949 and 1962, with subsequent work at key sites including Cerro Brujo (1334 faunal remains; Wing 1980; Linares & White 1980) and Sitio Drago on Isla Colón (15 mounds yielding 55 AMS radiocarbon dates cal. 561–1409 CE ; Wake et al. 2021) and 7 new archaeological sites as Swan Cay, Oriel, Orlando, Mimitimbi, Finca 910, Punta Drago Norte, Flores.

Fish assemblages across newly investigated sites reveal striking contrasts in resource procurement strategies linked to environmental positioning: the coastal site of Swan Cay yielded thousands of sea turtle and fish remains, while the inland elevated sites of Mimitimbi, Orlando and Oriel, located far from the shoreline, produced unexpectedly large fish assemblages alongside turtles, crocodiles and shells, raising important questions about mobility, exchange networks, and storage practices.

Pre-Columbian occupations in Bocas del Toro appear highly diverse, spanning from preceramic hunter-fisher-gatherer societies (eg. Sitio Lasquita, cal. 4850 - 4520 BCE) and agropastoral communities (eg. Black Creek, cal. 1880 - 590 BCE) to large and complex late ceramic polities (cal. 700 - 1500 CE) maintaining contacts with highland and Pacific Chiriquí across the mountain range. The fish-focused economic strategies documented at several sites invite comparison with contemporaneous Caribbean island societies (Greater and Lesser Antilles, or continental islands as Mar-

garita, Aruba, Bonaire and Curaçao), where marine resource exploitation was similarly central to subsistence systems. This work also addresses the vulnerability of coastal archaeological sites in a rapidly changing environment, while contributing to the broader understanding of regional exchanges between Central America and the Caribbean basin.

[S1.10-C] -Tuesday, September 29, 2026 (09:20)

Between reef and lagoon: pre-Columbian marine resource use at Indian Town Trail, Barbuda.

Sophia Perdikaris (1); Sandrine Grouard (2); Anaëlle Jailion (2); Hefeng Hu (2); Léo Sabatier (2)

(1) Department of Anthropology, University of Nebraska, Lincoln; (2) BioArch (UMR 7209) - Bioarchéologie, Interactions, Pratiques, Environnements - Muséum national d'Histoire naturelle

Keywords: archaeoichthyology; Antigua & Barbuda; Caribbean; pre-Columbian; subsistence marine resources

Abstract: The island of Barbuda in the Lesser Antilles has seen various waves of human occupation over the last 4000 years. During the Archaic Age (ca. 5000 - 500 BC), nomadic groups exploited the rich near shore areas to fish for West Indian conch and other species. The Ceramic Age Saladoid (ca. 200 BC - AD 900) and Troumassoid cultures (AD 900–1490) exploited both marine and inland environments. European colonization of the island began around AD 1628 and left a significant impact on Barbuda's environment although, unlike other islands, sugar cane was never grown on the island. The Colonial Period thus represents a reorganization of the landscape through agricultural practices, the introduction of new animal and plant species, and land subdivision. After emancipation (AD 1834), the people of Barbuda maintained sustainable fishing and farming practices and demonstrated resilience despite extreme climatic and weather events (hurricanes and droughts), and ongoing exploitative Colonial economic and political structures.

This presentation investigates faunal exploitation and pre-Columbian subsistence strategies at the Indian Town Trail site on Barbuda. By combining zooarchaeological, malacological, and technological analyses, it reconstructs the main environments exploited by Ceramic archaeological populations, with a strong emphasis on coastal ecosystems such as reefs, intertidal zones, mangroves, and lagoons. The study also highlights shell artifacts, ornaments, and tools, shedding light on technical know-how and cultural exchanges within the Lesser Antilles.

We also explore change in Pre-Columbian times through the study of different cultural horizons, combining archaeology, zooarchaeology, ethnobotany, archival documents, ethnography and environmental science to explore the long durée in a transdisciplinary perspective from the first peopling to the European contact, with reference to the unprecedented effects of the Anthropocene.



[S1.11-C] -Tuesday, September 29, 2026 (09:40)

Reef Fisheries and Coastal Resource Use in the Archaic Caribbean: Zooarchaeological Evidence from El Pozito (Dominican Republic)

Younes Naime (1); Carola Flores (2); Francesco Genchi (3); Alfredo Coppa (4); Emanuela Cristiani (5)

(1) Archaeological Park of Pompei, Naples, Italy; (2) Departamento de Historia y Ciencias Sociales, Universidad Adolfo Ibáñez, Vina del Mar, Chile; (3) Department of Italian Institute of Oriental Studies, Sapienza University of Rome, Rome, Italy; (4) Department of Environmental Biology, Sapienza University of Rome, Rome, Italy; (5) DANTE-Diet and ANcient TEchnology Laboratory, Department of Oral and Maxillo-Facial Sciences, Sapienza University of Rome, Italy

Keywords: Ichthyoarchaeology; Archaic period; Reef-Based Fishing; Dominican Republic; Caribbean Fisheries

Abstract: El Pozito, located approximately 2 km inland from the northeastern coast of the Dominican Republic, is a specialized shell-processing site and represents one of the earliest Archaic settlements documented in this region of Hispaniola (2nd - 1st Millennium BC). Chronological modelling based on multiple radiocarbon determinations indicates repeated episodes of occupation during the mid-Holocene, providing a secure framework for investigating early human engagement with coastal and marine ecosystems in the Greater Antilles.

This contribution focuses on fish remains as a proxy for reconstructing fish and coastal resource use. The ichthyofaunal assemblage is dominated by reef-associated taxa, including Epinephelinae, Lutjanidae, Labridae, Scaridae, Sparidae, and Carangidae, reflecting the use of fish from shallow marine habitats such as coral reefs, reef flats, and adjacent lagoonal systems. The taxonomic composition suggests a reliance on coastal fish resources and capture strategies adapted to structurally complex reef environments, while the absence of clearly pelagic species further supports the exploitation of coastal ecosystem.

These data are consistent with two alternative scenarios of resource acquisition, including direct capture in nearby coastal areas or the procurement of fish through exchange networks.

Fish remains occur alongside a wider range of mainly aquatic resources, including marine mollusks, marine turtles, and coastal birds, several of which exhibit traces of anthropogenic processing. Terrestrial resource are also present but in lower abundance, except for gastropods. These remains suggest a diversified subsistence strategy in which fishing played a central role in an inland workshop site, together with a broader coastal economy spanning multiple ecological zones.

Comparative evidence from the Greater and Lesser Antilles suggests that El Pozito differs from other specialized shell-processing sites, indicating a varied pattern of resource use. The presence of resources from coastal environments located approximately 2 km away further suggests recurrent use of the site associated with the exploitation of both aquatic

and terrestrial environments, although the organization and timing of occupations remain open.

Overall, this study contributes to ongoing discussions on the role of fish and coastal resources in archaeological sites located inland. Based on fish remains from El Pozito, we explore nearshore exploitation strategies, habitat use, and resource transport decisions, as well as human–reef interactions during the Archaic period. The study also highlights the analytical potential of fish assemblages for reconstructing variability in early coastal subsistence practices.

[S1.12-C] -Tuesday, September 29, 2026 (10:00)

Fish remains as indicators of human mobility in the Isthmo-Colombian area

Sergio Andrés Castro Méndez*

* Universidad Nacional del Centro de la Provincia de Buenos Aires

Keywords: ichthyoarchaeology; human mobility; aquatic landscapes; Colombian Caribbean; Isthmo-Colombian Area

Abstract: Fish remains have played a fundamental role in the reconstruction of subsistence practices, fishing strategies, and the relationships between human societies and aquatic environments.

This paper explores their potential for investigating human mobility. Through a comparative analysis of ichthyoarchaeological assemblages from the Colombian Caribbean and the Tropical Eastern Pacific, it examines how taxonomic composition can provide insights into the spatial scales involved in resource procurement and the different ways in which past communities articulated their relationships with marine environments.

The first case study draws on evidence from several Late Pre-Hispanic sites in the Lower Magdalena region (12th - 16th centuries AD), where marine and freshwater fish are represented in contrasting ways. Some settlements located near the coast are dominated by species associated with wetlands, floodplains, and other continental environments, whereas certain sites situated farther inland contain substantial quantities of marine fish.

These differences suggest that patterns of human mobility were influenced by the diversity of resources available within the ecological niches exploited by past communities.

The second case study focuses on the Middle Holocene site of Pedro González in the Pearl Islands of Panama. In this context, the assemblage is dominated by species closely associated with coral reefs and coastal habitats readily accessible from the settlement. The taxonomic composition suggests intensive exploitation of locally available resources and points to a subsistence strategy largely based on highly productive nearby ecosystems.

Based on the comparison of these contexts, this paper proposes an interpretive framework for evaluating human mobility through ichthyoarchaeological assemblages in tropical environments.

This approach considers species ecology, the distribution of



aquatic habitats, and archaeological context as key variables for discussing the extent of catchment areas, dependence on local resources, and connections among different ecosystems.

[S1.13-C] -Tuesday, September 29, 2026 (10:20)

Fishing in the Red Sea. Changing strategies, various fishing grounds or environmental changes?

Urszula Iwaszczuk (1); Aurélia Borvon (2)

(1) Institute of Mediterranean and Oriental Cultures, Polish Academy of Sciences, Warsaw, Poland; (2) UMR 7041 ArScAn Nanterre, France; Anatomie Comparée, Oniris VetAgroBio Nantes, France

Keywords: fishing strategies; fishing grounds; Red Sea; fish remains; archaeoichthyology

Abstract: Unlike the Persian Gulf, the Red Sea region is very poorly understood with respect to the fishing and fishing grounds used by coastal inhabitants in the past, largely due to the limited number of analysed bone assemblages. The marine fish trade from this area has not yet been discussed. Therefore, we would like to include this region in the scientific archaeoichthyological debate. The data we collected covers over two millennia, from the Hellenistic period to modern times. The analysed sites were located on

the western and eastern coasts of the Red Sea. The assemblages varied in the number of remains analysed; some came from only small surveys, others from extensive multi-season studies. However, taken together, they paint an interesting picture indicating differences between the western and eastern coasts of the Red Sea in environmental conditions and exploited fishing grounds. In some cases, we were also able to follow diachronic changes. Overall, only seven families were of major economic importance. Most of these, including fish from Serranidae, Lutjanidae, Lethrinidae, Sparidae, and Scaridae families, are reef-associated and shallow water dwellers, as are almost all fish species whose remains appear only sporadically in the records. In the case of fish from the Carangidae and Scombridae families, these can be found both in littoral waters, including habitats associated with coral reefs, and offshore.

However, some species, such as tuna, are typical open-water dwellers, inhabiting the epipelagic and mesopelagic zones.

Additionally, some Nilotic fish, mostly catfish, tilapia and cyprinids, were recorded not only at the western (Egyptian) coast sites but also at the northern part of the eastern coast. They were certainly traded, but could the bones of some marine fish also indicate fish trade within the Red Sea? And what was the reason for the diachronic changes in taxonomic composition in fish bone assemblages from large Red Sea port towns? In our paper, we seek answers to these questions. The aim is to analyse Red Sea fisheries using both published and recently analysed unpublished data that have not yet been included in the scientific debate.

Session 2

Anthropogenic impact on marine environments

[S2.1-A] -Tuesday, September 29, 2026 (11:20)

Past distributions of exploited teleost fishes: an ecological baseline for interpreting archaeo-fisheries

Sarah Mathilde Salomé Beauvais (1); Emna Ben Lamine (1); Tatiana Theodoropoulou (2); Gabriele Carenti (2,3); Guillaume Leduc (4); Virginie Raybaud (1)

(1) Université Côte d'Azur, CNRS, ECOSEAS, France; (2) Université Côte d'Azur, CNRS, CEPAM, France; (3) Service d'Archéologie Métropole Nice Côte d'Azur; (4) CEREGE, Aix Marseille Univ, CNRS, IRD, INRAE, Coll France, Aix-en-Provence, France

Keywords: Archaeo-fisheries, Last Glacial Maximum, Mediterranean Sea; Mid-Holocene; Species Distribution Modelling

Abstract: Marine historical ecology provides a long-term perspective on the interactions between environmental change, marine resources and human societies, offering new

insights for the interpretation of archaeozoological records. Within the MERMAID project, we investigate how past climatic fluctuations may have influenced the geographical distributions of exploited fish species in the Mediterranean Sea. Understanding these natural changes is essential for distinguishing environmental signals from human impacts and for establishing long-term ecological baselines.

We reconstructed the potential past distributions of 17 teleost fish species commonly recovered from archaeological sites around the Mediterranean and adjacent European coasts. Using ecological niche modelling, present-day species–environment relationships were projected onto palaeoclimatic reconstructions for two contrasting periods: the Mid-Holocene (6 ka BP) and the Last Glacial Maximum (21 ka BP). These reconstructions allowed us to compare changes in the extent and location of environmentally suitable habitats through time and to identify broad latitudinal trends.

Our results reveal little difference between the Mid-Holocene and the present, suggesting relatively stable environmental conditions for the studied species throughout the



Holocene. In contrast, the Last Glacial Maximum led to marked but species-specific reorganizations of potential distributions. Temperate species generally shifted towards lower latitudes, while subtropical species experienced substantial contractions of suitable habitats. Coastal species were more strongly affected than offshore taxa, reflecting the combined influence of sea surface temperature and coastline configuration.

Comparison with available archaeozoological occurrences shows a strong agreement between predicted suitable areas and the archaeological record, supporting the role of environmental constraints in structuring past fisheries and local exploitation opportunities. By reconstructing the potential availability of marine resources under contrasting climatic conditions, this study provides an environmental framework for interpreting fish remains from archaeological sites and contributes to a better understanding of the long-term relationships between climate, marine ecosystems and coastal societies.

[S2.2-A] -Tuesday, September 29, 2026 (11:40)

Leveraging regional-scale archaeological fish data to explore multi-century historical fisheries from the Chesapeake Bay area

Hayden A. Bernard (1); Ryan Kennedy (1); Eric Guiry (2); Paul Szpak (3)

(1) Indiana University Bloomington; (2) McMaster University; (3) Trent University

Keywords: Historical Archaeology; Chesapeake Bay Area; Commercial Fisheries; Historical Ecology; Socio-ecological Systems

Abstract: The Chesapeake Bay, situated along the east coast of the United States, is the largest estuary in North America and was the location for some of the earliest European colonies, such as Jamestown and Williamsburg. As colonial efforts spread across the landscape, Europe and the Americas were interlinked through systems of resource extraction driven by colonial capitalism, trade, and rapid demographic shifts, culminating in the decline of environmental health and the depletion of ecological systems.

As such, the past four centuries in the Chesapeake Bay have been characterized by the intensive harvest of natural resources, landscape transformations, and the subsequent exhaustion of animal populations, which have severely affected the fish populations from which these systems of extraction relied on.

This paper uses a dataset of archaeological fish remains from sites across Maryland and Virginia dating from the past four centuries to explore notable features and shifts in Chesapeake Bay historical fisheries through patterns of species abundance, taxonomic diversity, spatial distribution, and market preference.

In addition to identifying previously undocumented trends in fish harvesting in a region and timeframe marked by rapid urban development and technological changes, this research emphasizes the importance of targeted

methodological approaches such as stable isotope and body size estimation analyses to reveal nuances and insight into the historical ecology of fishes through decline in body length driven by overfishing and variability in harvesting locations over time. By tracing the historical ecology of fishes and how people have historically valued nature, we seek to demonstrate how the historical fisheries of the Chesapeake Bay can be broadened to better comprehend the situations of the modern world. Given that many of the issues that affect modern fisheries such as overharvesting, invasive species, water pollution, and biodiversity loss originated in the past, we argue that zooarchaeological research has an important role in providing baseline data to better understand this history of socio-ecological interactions that link to the fisheries of today.

[S2.3-A] -Tuesday, September 29, 2026 (12:00)

Archaeological fishes and bivalves reveal long-term ecosystem change in a Mediterranean coastal lagoon through compound-specific amino acid isotope analysis

Audrey Marguin (1,2); Francesca Rossi (1); Laury Açaf (3); Aymeric Vignier (2); Matthew McCarthy (4); Tatiana Theodoropoulou (2)

(1) Department of Integrative Marine Ecology (EMI), Genoa Marine Centre (GMC), Stazione Zoologica Anton Dohrn - National Institute of Marine Biology, Ecology and Biotechnology, Villa del Principe, Genoa, Italy; (2) CNRS, Cultures, Environnements, Préhistoire, Antiquité, Moyen Âge (CEPAM, UMR 7264), Nice, France; (3) Laboratoire d'Océanographie de Villefranche sur Mer, LOV - UMR7093 CNRS, Villefranche sur Mer, France; (4) University of California Santa Cruz, Department of Ocean Science, 1156 High Street, Santa Cruz, CA, 95060, USA

Keywords: Diachronic study; historical ecology; fish bone collagen; Stable isotopes

Abstract: Mediterranean coastal lagoons have supported human communities since prehistory, providing important fisheries resources while undergoing substantial ecological change driven by both natural processes and increasing anthropogenic pressures. The long archaeological record preserved around these environments offers a unique opportunity to investigate how human exploitation and settlement have shaped aquatic ecosystem functioning through time.

In this study, we reconstruct the trophic ecology of fishes and bivalves from the Berre Lagoon (southern France) from the Mid-Holocene to the present, spanning approximately 9000 years.

We applied $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ compound-specific stable isotope analysis of amino acids to fish bone collagen and shell organic matrix. We focused on three economically important and historically exploited fish species (*Dicentrarchus labrax*, *Sparus aurata*, and *Sarpa salpa*) and one clam (*Ruditapes decussatus*).

Archaeological specimens recovered from sites surrounding the lagoon were compared with modern individuals to investigate



stigate long-term changes in resource ecology and ecosystem structure.

Comparison of amino acid isotope patterns indicates that original ecological information is well preserved over millennial timescales, demonstrating the value of archaeological fish bones and shells as long-term ecological archives. Preliminary results reveal early shifts in carbon sources supporting the lagoon food web, coinciding with the establishment and intensification of human occupation around the lagoon. In contrast, nitrogen source signatures exhibit a more recent shift consistent with increasing anthropogenic nutrient inputs.

These changes are associated with significant variations in trophic levels, reflecting long-term alterations in food-web structure and ecosystem functioning. Our results suggest that the ecological context of exploited fisheries resources has changed substantially through time, tracking both human activities and environmental transformation. More broadly, this study demonstrates how compound-specific isotope analysis of archaeological fish and shell remains can provide unprecedented insights into the historical dynamics of coastal ecosystems and establish long-term ecological baselines relevant to fisheries management and ecosystem restoration.

[S2.4-A] -Tuesday, September 29, 2026 (12:20)

Synthesis of Atlantic cod (*Gadus morhua*) and saithe (*Pollachius virens*) size-at-catch data from northern Scotland indicates limited impact of pre-industrial fisheries

David Orton (1); Jen Harland (2); Mik Lisowski (1); Rowan McLaughlin (1)

(1) University of York; (2) University of the Highlands and Islands

Keywords: length estimation; overfishing; climate; demersal fisheries; Gadidae

Abstract: Industrial fisheries are known to have had severe impacts on marine fish stocks globally. The potential cumulative impact of previous, lower-intensity catches is much harder to evaluate: with systematic records rarely reaching back more than a century, zooarchaeological remains – with all their limitations – often represent the main, or only, source of evidence. In the case of North Sea demersal fisheries, industrialisation is represented by the introduction of steam-powered trawlers in the late 19th century, but this was preceded by almost a millennium of often quite intensive pre-industrial fishing.

Here we explore the beginnings of detectable human impact on northern North Sea cod and saithe via catch size data, aiming to test the hypothesis that a gradual size decline due to fishing pressure began prior to industrialisation. We present new Bayesian regression models for cranial bones and apply these to a dataset of around 1500 individuals from 12 sites in northern Scotland spanning the 10th-19th centuries, with International Bottom Trawl Survey (IBTS) data from 1970-2025 for comparison.

We observe a consistently bimodal distribution of cod size-at-catch throughout the archaeological dataset, with c.500mm and c. 1000 mm peaks that we interpret as inshore vs. deep water fishing. While mean size does decrease from the 16th century this appears to reflect changing fishing practices rather than reduced availability of larger fish: there is no sign of a decline in the upper peak, with appreciable numbers of c.1m fish evident even in the most recent archaeological material. This contrasts sharply with the IBTS data, in which this larger group appears absent.

Both the smaller group of cod and the saithe show a gradual decline in size through the late medieval and early modern periods, however. This could reflect either localised fishing impacts in coastal water or – arguably more likely – the impact of climatic cooling on juvenile growth rates.

Overall, we conclude that pre-industrial fisheries had limited impact on northern North Sea gadid size distributions, while a dramatic decline in cod sizes took place in the decades following the introduction of the steam trawl.

[S2.5-A] -Tuesday, September 29, 2026 (12:40)

Towards an archaeology of acclimatization societies and 19th-century animal introductions

J. Ryan Kennedy*

* Indiana University Bloomington

Keywords: Non-native species; animal commodification; trade; globalization; zooarchaeology

Abstract: The 19th century was marked by dramatic shifts in the ways that people interacted with, harvested, consumed, and managed wild animals, including fishes. Alongside expanding global trade and resource extraction, the period saw growing recognition of the impacts that humans have on wild animals and the concomitant need for human management of these organisms and their environments.

In this context, the zooarchaeology of 19th-century fishes often focuses on themes like cuisine, trade, and, increasingly, the effects of overfishing. Less well-understood archaeologically is the widespread and intentional introduction of numerous species of animals and plants to settler colonial nations around the globe beginning in the mid-19th century by “acclimatization societies.” The first acclimatization societies formed in Europe in the 1850s, beginning with France and spreading to other colonial powers. While these organizations initially sought to introduce valuable exotic plants and animals to the colonial core, offshoots soon sprung up in settler colonial territories with similar goals of re-shaping these places through species introductions. Acclimatization societies often identified target species for introduction by members, provided material and informational support, and even offering bounties for successful introductions of particularly valued species. Society memberships frequently included fisheries scientists and government officials whose extensive knowledge and reputations lent legitimacy to the organizations' efforts and whose resources and connections facilitated sourcing, shipment, rearing, and introduction to new habitats.



In this paper, I discuss archaeological implications of acclimatization societies. This includes not only the introductions of myriad species to settler colonial territories across the globe, but also the drivers and motivations behind them, such as prior species collapses, increasing market demand, and growing scientific focus on wild animals. I draw on several case studies, including the introductions of 1) common carp from Europe to eastern North America, 2) American shad, bullhead catfishes, and striped bass from eastern North America to California, and 3) multiple salmonids, including rainbow trout and Chinook salmon, from California to New Zealand. Although parts of these processes, including harvest and the construction of fish hatcheries, played out at local and regional scales, the actions and effects of acclimatization societies were global in scope. Members shared information, strategies, and organisms, and they shaped ecosystems at scales difficult to comprehend with traditional site-based archaeology. In this context, I ultimately aim to show how archaeological data can be leveraged to understand these processes not only at a local level but, more importantly, at the scale at which acclimatization societies operated.

[S2.6-B] -Tuesday, September 29, 2026 (14:40)

Reconstructing population dynamics of the european sardine (*Sardina pilchardus*) using palaeogenomics

Gonçalo Espregueira Themudo (1); Inês M. dos Santos (1); Rebecca L.S.T. Netels (1); Adolfo Fernández (2); Sónia Gabriel (3); Carlos Fernández-Rodríguez (4); Yvon Dréano (5,6); Brice Ephrem (6); Gaël Piquès (7); Arnau Brosa-Pla-nella (8); Aurélia Borvon (9); Irit Zohar (10); Gloria González Fortes (11); Rute R. da Fonseca (12); Paula F. Campos (1)

(1) CIIMAR – Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Porto, Portugal; (2) Faculty of History, Department of Art, Geography and History, University of Vigo, Ourense, Spain; (3) Archaeosciences Laboratory (LARC), Cultural Heritage, P.I. (PC.I.P.), Lisbon, Portugal; (4) Departamento de Historia, Universidad de León, Spain; (5) Eveha-Tours; (6) CNRS, CReAAH Laboratoire Archéosciences, UMR 6566, University of Rennes, Rennes, France; (7) Archéologie des Sociétés Méditerranéennes, CNRS, Université Paul Valéry, Montpellier 34199, France; (8) Seminari d'Estudis i Recerques Prehistòriques (SERP), Department of History and Archaeology, Universitat de Barcelona, Barcelona, Spain; Institute of Archaeology of the University of Barcelona (IAUB), Barcelona, Spain; (9) UMR 7041 ArScAn Equipe Archéologies Environnementales, Nanterre, France & Laboratoire d'Anatomie Comparée, Oniris VetAgroBio Nantes, France; (10) Department of Biology and Environment, University of Haifa, Oranim, 3604301, Israel; and Marine Biodiversity Centre, The Steinhardt Museum of Natural History, Tel Aviv University, 699780, Tel Aviv, Israel; (11) Instituto Universitario de Xeoloxía (IUX), Universidade da Coruña, A Coruña (Spain); (12) The Globe Institute, Faculty of Health and Medical Sciences, University of Copenhagen, Denmark

Keywords: ancient DNA; overfishing; resource exploitation
Abstract: Overfishing has severely affected numerous marine species, reducing their effective population sizes to a fraction of their historical levels. Yet, because reliable catch records are often lacking, our understanding of how these pressures have shaped species' evolutionary trajectories remains limited.

One of the most impacted species is the european sardine (*Sardina pilchardus*), a key pelagic resource in Atlantic waters and of major economic importance, particularly in Southern Europe and Morocco, where it is the primary target of purse-seine fisheries and a critical source of income for coastal communities. The species ranges from the southern Celtic Sea and North Sea to Mauritania and Senegal, including the Azores, Madeira, and the Canary Islands, and is also abundant throughout the Mediterranean. Current populations form three genetic clusters: one comprising individuals from the Azores and Madeira; a second encompassing Iberian populations, which occupy the centre of the sampling range; and a third containing Mediterranean and Canary Islands individuals, with Iberian sardines showing signs of admixture. In this study, we apply state-of-the-art ancient DNA approaches to specimens predating periods of intensive fishing and compare their genetic profiles with those of modern, post-exploitation populations. This enables us to examine genetic continuity over time and compare levels of genetic diversity before and after exploitation, providing essential baselines for stock delineation, fisheries management, and determining appropriate fishing effort across the various FAO areas.

[S2.7-B] -Tuesday, September 29, 2026 (15:00)

The marine ecosystem from the perspective of the sardine fishery on the French Atlantic coast during the eighteenth century

Hiroyasu Kimizuka*

* Waseda University, Faculty of Social Sciences

Keywords: history; fishery; sardine; maritime; Brittany
Abstract: By introducing the idea of the Anthropocene into history, C. Bonneuil, a historian of science, highlighted the link between human activities and the natural environment. Although historians have emphasized the influence of the Industrial Revolution of the late eighteenth century on the environmental change of the globe, the long history of interaction between nature and humans should not be ignored. Taking the maritime society into consideration, fisheries serve as an excellent illustration of this interaction during the early modern era.

Pressed sardines had represented the popular aquatic food in the southern France, such as the Languedoc and the Provence, from the medieval times. Despite a decline in sardine catches in the Mediterranean region by the end of the seventeenth century, demand for pressed sardines in southern France persisted. The dynamics of the consumer market spurred the emergence of pressed sardine production along the French Atlantic coast in the eighteenth century.



Located in the migratory routes of Atlantic sardines, the region of Brittany was the most crucial area for sardine fishing and the manufacture of pressed sardines during the eighteenth century.

Consequently, there was an increase in the pressed sardine trade between the southern coast of Brittany and Bordeaux, where this product was transported to the cities of Languedoc via ships on the Garonne river. It is likely that this development of the sardine trade stimulated economic activities of the small harbor towns, especially, located in the southern part of the Brittany peninsula such as Le Croisic, Belle-île, Port Louis, Concarneau, Douarnenez, and Camaret.

The growth of the production and the trade of pressed sardines

brought several economic effects such as the increase of the income of merchants and fishermen in the province of Brittany.

However, the compressed sardine commerce was not consistently profitable. In fact, the environmental factors such as the decrease of sardines influenced the price of the pressed sardines. Moreover, as sardine fishing expanded rapidly, there was a corresponding increase in fraudulent fishing for small shrimps and fries, which were often used as bait.

The objective of this paper is to comprehend the historical relationship between nature and human economic activities using the French Atlantic coast sardine fishery as a case study in the 18th century.

Session 3

Fishing practices, processings and trades

[S3.1-A] -Tuesday, September 29, 2026 (15:20)

Oronsay Revisited: first results from new excavations at the Mesolithic shell midden site of Cnoc Coig, Scotland

Jen Harland (1); Niklas Hausmann (2); Harry Robson (3); Stephanie Piper (4); Holly Young (1)

(1) Archaeology Institute, University of the Highlands and Islands; (2) Römisch Germanisches Zentralmuseum (RG-ZM) Leibniz Research Institute for Archaeology; (3) Independent researcher; (4) British Museum

Keywords: Mesolithic; Scotland; otoliths; inshore fishing; marine shell

Abstract: In July 2025 a small team re-excavated trenches at the iconic Mesolithic shell midden site of Cnoc Coig, on Oronsay. This site was excavated in the 1970s by Paul Mellars and colleagues, and previous archaeoichthyological work primarily focussed on the otoliths studied by Michael Wilkinson during his PhD. The subsequent publication 'Fish otoliths as indicators of seasonality in prehistoric shell middens' (Mellars and Wilkinson 1980) concluded that Cnoc Coig was only inhabited during the autumn, and these conclusions influenced decades of thought about seasonal use and movement during the Late Mesolithic. Yet, the wider fish assemblage was never fully published, and questions remained unanswered.

Our excavation hopes to fill some of these gaps. By locating and opening up a trench edge from the 1970s excavation, we were able to excavate a small new area of the shell midden, making use of pre-existing contextual definitions and dating. Whole-earth samples were taken for full analysis, including future application of sedaDNA. Biomolecular methods are being used to investigate seasonality using the dense accumulations of limpet shells excavated.

Results from our newly excavated fish remains will be presented here, showing that the site is indeed dominated by small, juvenile saithe (*Pollachius virens*), along with some other species. While these animals would have made a valuable contribution to the diet, the oil from their livers may

have been important for lighting, cooking, or other uses, and this must not be overlooked. The extraordinarily good preservation of both bone and otoliths permits metrical analysis and thus size reconstructions. Element patterning hints that some processing was taking place, with some body parts over- or under-represented in some contexts. This can allow us to ask questions about preservation and consumption patterning. Size variation was present at context level, suggesting seasonally-based exploitation patterning probably occurred, and this will be presented alongside conclusions from limpet seasonality to show a more nuanced understanding of seasonal resource use on Oronsay.

[S3.2-A] -Tuesday, September 29, 2026 (15:40)

Small Fish, Big Questions: explaining fish size during the Mesolithic-Neolithic transition in the Mediterranean

Aymeric Vignier (1); Gabriele Carenti (1,2); Tatiana Theodoropoulou (1)

(1) Université Nice Côte d'Azur, CNRS, UMR7264 CE-PAM; (2) Service d'Archéologie Métropole Nice Côte d'Azur

Keywords: Mediterranean; Mesolithic-Neolithic; fish species; size distribution; climatic change; fishing strategies

Abstract: The Mesolithic–Neolithic transition in the Mediterranean was accompanied by numerous environmental and societal changes. Human communities experienced climatic warming and rising sea levels, both of which may have influenced their subsistence strategies and partly contributed to the emergence of agropastoralism and the onset of the Neolithic. However, to what extent did these changes affect the role of aquatic resources during this transition ?

The archaeoichthyological analysis of a number of Mesolithic and Early Neolithic sites from the Mediterranean reveals interesting patterns in the species representation and



size distribution of fish caught during this period. Surprisingly, many specimens appear to have been relatively small. Why were fish catches so small during these early periods? Several hypotheses may explain this pattern. Did environmental changes influence fish size? Was this the result of human choice or selective fishing practices? Or was it related to the fishing techniques employed by these communities? In this presentation, we will explore these hypotheses and discuss the factors that may explain the observed size of fish catches.

[S3.3-B] -Tuesday, September 29, 2026 (16:40)

Bone hooks and fish remains: an integrated study of prehistoric fishing practices in Norway

Albane Mazet (1,2)

(1) Université Paris Nanterre - UMR7041 ArScAN – An-Tet; (2) Université Côte d'Azur - UMR 7264 CEPAM

Keywords: bone industry; fishing; prehistory; Norway; fish-hook

Abstract: This communication investigates how fishing practices evolved along the Norwegian coast from the Mesolithic to the Metal Ages and explores the social and economic processes underlying these transformations. To do so, it combines a techno-functional analysis of bone fishhooks with published ichthyological data in order to reconstruct the organisation of fishing activities through time and assess their changing role within coastal societies.

The technological study first examines raw material selection and its volumetric influence on fishhook morphology. Manufacturing sequences are then reconstructed to identify the different stages of production and the technical choices made by prehistoric craftspeople. Fishhook structures are analysed according to functional parameters related to hooking efficiency and fish retention, while recurring technological and structural traits are used to identify the criteria that guided design and manufacture.

The results reveal a relatively standardised production of fishhooks throughout both the Middle and Late Mesolithic. With the advent of the Neolithic, however, fishhook forms underwent a marked typological and functional diversification. This phenomenon reflects a period of innovation and experimentation in fishing practices, while maintaining strong links with earlier technical traditions. Despite these changes, the size range of captured fish appears to have remained broadly similar between the Mesolithic and the Early Neolithic, suggesting continuity in targeted resources. A more substantial transformation occurred during the second half of the Neolithic, with the emergence of very large fishhooks indicative of the capture of large fish species. At the same time, fishhooks comparable in size to earlier examples evolved into composite artefacts produced through more expedient manufacturing processes requiring lower technological investment. By the end of the Neolithic, the analysis identifies a clear duality in fishing strategies: on the one hand, an offshore fishery relying on highly invested and sometimes decorated hooks designed to target large

specimens; on the other, a more domestic subsistence fishery employing expedient composite hooks and perpetuating long-established practices. This technological dichotomy may reflect emerging processes of economic specialisation and social differentiation within coastal communities. More broadly, the study demonstrates how changes in fishing technologies can provide insights into the evolving social status of fishers.

Beyond documenting changes in hook technology and fishing organisation, this research also reassesses the role of fishhooks within broader fishing systems. While the vast majority of identified fish remains belong to gadids — particularly Atlantic cod (*Gadus morhua*), pollack (*Pollachius pollachius*), and saithe (*Pollachius virens*) — archaeological assemblages also contain a range of less common taxa whose capture may not always be readily explained by hook fishing alone. The ubiquity of fishhooks in coastal sites has often led to their interpretation as the primary fishing technology. However, the taxonomic diversity of the faunal record invites consideration of complementary equipment, such as harpoons and nets, suggesting a broader and potentially more diversified spectrum of fishing practices than that reflected by fishhooks alone.

[S3.4-B] -Tuesday, September 29, 2026 (17:00)

Sieving for bones: freshwater fish exploitation in the Po Plain during the Bronze Age

Vito Giuseppe Prillo (1); Marco Baioni (2); Andrea De Martino (3); Valeria Sarnico (4); Massimo Vidale (1)

(1) Department of Cultural Heritage, University of Padua, Italy; (2) Museo Archeologico della Valle Sabbia, Gavardo, Italy; (3) Independent researcher; (4) Acronos Srl, Monticelli Brusati, Italy

Keywords: Ichthyoarchaeology; Bronze Age; Po Plain; Pile-dwelling sites; Terramare

Abstract: Fish remains are notoriously underrepresented in archaeological assemblages, primarily due to taphonomic biases and recovery strategies. In particular, the absence of systematic sieving has significantly limited the identification of ichthyofaunal remains, leading to an underestimation of the role of fishing in Bronze Age subsistence systems in regions such as northern Italy.

This study presents new and largely unpublished ichthyoarchaeological data from two key sites of the Po Plain investigated within a broader PhD project: the pile dwelling context of Lucone di Polpenazze (Early Bronze Age) and the Terramare site of Pilastrì di Bondeno (Middle - Late Bronze Age).

These case studies represent two major settlement types linked to distinct cultural and chronological frameworks in the region, thus offering an opportunity to investigate how different socio-environmental contexts closely linked to aquatic settings shaped the management and exploitation of fish resources.

The assemblages were analysed through taxonomic and biometric approaches, combined with contextual and methodo-



logical evaluation of recovery techniques, with particular attention to the impact of sieving on fish bone retrieval.

Preliminary results highlight a clear predominance of freshwater taxa, especially pike (*Esox lucius*) and cyprinids, confirming a systematic and locally grounded exploitation of aquatic habitats.

At Lucone, the data suggest a structured and possibly specialized exploitation of lacustrine resources, coherent with the organization of pile-dwelling communities. At Pilastrì, the ichthyofaunal assemblage reflects a more diversified strategy adapted to fluvial and wetland environments, consistent with the economic flexibility of Terramare systems.

The comparison between these sites, integrated with other faunal categories, also considers the limited evidence of fishing equipment (such as hooks, net weights, and related implements), traditionally used as indirect proxies for fishing activities.

The discrepancy between these artefacts and the ichthyological record further emphasizes how recovery biases — particularly the lack of systematic sieving — have affected the visibility of fish exploitation in Bronze Age contexts.

This integrated perspective is further explored through comparisons with the limited published data from northern Italy, combining ichthyofaunal evidence, faunal assemblages, and fishing-related artefacts in order to better assess regional variability in aquatic resource exploitation.

Finally, GIS-based spatial analyses will be implemented to map the distribution of ichthyofaunal evidence and evaluate relationships between settlement types, environmental settings, and fishing strategies at a regional scale.

By integrating zooarchaeological data, methodological considerations, and spatial analysis, this study aims to reassess the variability and significance of fishing practices within Bronze Age economic systems of the Po Plain.

[S3.5-B] -Tuesday, September 29, 2026 (17:20)

Coastal subsistence in Bronze Age and Iron Age Norway: specialized fishing settlement at Selje

Syrielle Fayet (1); Konrad Smiarowski (1)

(1) University Museum of Bergen

Keywords: marine fishing; Bronze / Iron Age; Norway; surplus; midden

Abstract: Selje is an archaeological site excavated in 2023 by the University Museum of Bergen. It is located in Western Norway, and its occupation spans from the Late Neolithic to the Pre-Roman Iron Age. The site is an open-air settlement with well-preserved stratified middens continuously used from the Late Bronze Age to the Pre-Roman Iron Age. The organic preservation is giving us a unique insight into coastal subsistence strategies in prehistoric Norway, up till now mostly studied through cave and rock shelter sites. The ongoing zooarchaeological analysis reveals a high amount of fish remains, mostly large gadid specimens of cod (*Gadus morhua*), saithe (*Pollachius virens*) and ling (*Molva molva*). Moreover, the presence of shellfish and red deer remains hints toward a seasonal and specialized resource management model.

The analysis has for now focused on the identification of fish remains, as well as the production of a complementary large-scale dataset on gadid size reconstruction. Species diversity, skeletal representation and other variables in the assemblage are hinting towards a consistent processing of the fish remains. The specialized shell middens are currently being analyzed. The overall small proportion of mammal and bird remains is contributing to our focus on the study of marine resources.

This presentation will introduce ichthyofaunal results from a few large midden contexts from the Bronze Age to Iron age transition. They are representative of the highly specialized and standardized marine fishing at Selje. Data analysis from these contexts leads us to broader discussions on the seasonality of the subsistence strategy and patterns of resilience in marginal Nordic areas. Despite clear signs of agricultural activity on site, this case shows how heavily local populations were still dependent on marine -and more generally wild- resource exploitation. Ultimately, this leads us to reflections on long-term resilience in the North Atlantic and broadens our perspectives on past and future adaptations to environmental changes.

Poster Session

[S1.101-P] -Wednesday, September 30, 2026

Paleoclimatic factors and variability of consumption of ichthyological species during the Early Formative (1800 – 1500 BCE.) In Vichama, Huaura Valley, Peru

Luis Roberto Miranda Muñoz*

* Universidad Nacional Mayor de San Marcos. Lima Peru.

Keywords: Huaura Valley; Caral civilization; fish remains

Abstract: The ichthyological analysis of Vichama (1800 - 1500 BCE), a settlement in the Huaura Valley, provides

new evidence on the relationship between climate variability, marine resource exploitation, and social transformations during the final stage of the Caral civilization. The study focused on the taxonomic identification and quantification of fish remains across six occupational periods, with special emphasis on *Engraulis ringens* (anchoveta) as a bioindicator species. Results indicate the constant predominance of anchoveta throughout all periods, highlighting the stability of fishing as a subsistence strategy and the likely use of preservation technologies (drying, salting). However, relative frequency variations were observed, particularly in Period 2, marked by a significant decline of anchoveta and the appearance of warm-water species such as *Isurus oxyrin-*



chus and *Triakis maculata*, consistent with a moderate El Niño event. These findings suggest that the inhabitants of Vichama faced environmental fluctuations without evidence of catastrophic events, adapting their exploitation and redistribution practices within a mixed agropastoral and fishing economy. Overall, the ichthyological sequence of Vichama offers a robust quantitative baseline to understand how social resilience was structured in response to climatic instability, helping to explain the persistence of this settlement while other centers of the Caral civilization were abandoned.

[S2.101-P] -Wednesday, September 30, 2026

Flanders' Riverine Exploitation and ecoSystems throughout History - FRESH: an intro

Katrien Dierickx (1); Jessica Hendy (2); Christophe Snoeck (1)

(1) Archaeology, Environmental Changes & Geo-Chemistry Research Group, Vrije Universiteit Brussel, Brussels, Belgium; (2) Department of Archaeology, University of York, York, UK

Keywords: Cypriniformes; *Esox lucius*; Biogeochemistry; Freshwater biology; Medieval history

Abstract: Historical records indicate that the onset of severe anthropogenic impacts on rivers, such as pollution and biodiversity loss, in western Europe started during the medieval and postmedieval periods due to an increase in the number and size of cities, industries, and other activities, such as agriculture, tanning, textile production, overfishing, modifying water courses via dams or straightening rivers, and introducing invasive species. However, the nature and scale of this change has not been examined by archaeological research.

Furthermore, in order to provide necessary pre-modern baselines to support modern day conservation in one of Europe's most extensive and dynamic habitat types, an in-depth bioarchaeological approach is needed.

A dense river network, large town centres with large populations, and intense agricultural and industrial activities during the medieval and postmedieval periods, make Flanders highly suited as a first case study to investigate the chronology and magnitude of anthropogenic impacts on rivers.

The aim of this interdisciplinary project, Flanders' Riverine Exploitation and ecoSystems throughout History (FRESH), is to determine how freshwater fish exploitation and ecosystem health changed during the medieval and postmedieval periods in relation to socioeconomic and human-induced environmental changes in Flanders. In this poster, the objectives, outline, and methodologies of the project are explained.

Multiple methodologies and an interdisciplinary approach are at the core of FRESH. Historical and archaeological knowledge will provide background information to interpret and chronologically frame data obtained from palaeoproteomic and biogeochemical analyses. Palaeoproteomic analysis will provide species-specific identification of bone

fragments, which is often lacking in archaeological studies, and allows high taxonomic resolution needed to refine biogeochemical work with elemental (Hg and Pb) and stable isotope (C, N, S, O, and Sr) analyses, which in turn can complement historical and archaeological insights in past freshwater ecosystems and anthropogenic impacts.

These methods will be refined and applied on archaeological freshwater fish bones and teeth of Cypriniformes and *Esox lucius* from various sites in Flanders to make species-specific interpretations on the geographical origin of the fish, their ecology, and pollution of their environments. The obtained pre-modern baselines of historical species diversity, habitat degradation and the long-term effects of pollution on river environments will be of use to evaluate and support modern-day conservation.

[S3.101-P] -Wednesday, September 30, 2026

Fishing equipment in the Mediterranean from prehistory to Antiquity: current knowledge, technological developments and research gaps

Albane Mazet (1,2); Gabriele Carenti (1,3); Tatiana Theodoropoulou (1)

(1) Université Nice Côte d'Azur, CNRS, UMR7264 CEPAM; (2) Université Paris Nanterre, UMR7041 ArScAn, AnTet; (3) Service d'Archéologie Métropole Nice Côte d'Azur

Keywords: Fishing tools; Prehistory; Bronze Age; Antiquity

Abstract: This poster presents a synthesis of current knowledge on fishing equipment documented across the Mediterranean basin from Prehistory to Antiquity compiled within the ERC MERMAID research program. Its aim is to establish the geographical and chronological distribution of fishing implements, document their technological and functional developments through time, and identify the principal gaps and limitations in the available archaeological record.

The study compiles evidence for the main categories of fishing equipment recovered in Mediterranean archaeological contexts and examines their development across different periods and regions.

Fishhooks represent one of the most widely documented fishing implements. First manufactured from bone, they are attested from Mesolithic contexts, alongside gorges, and were increasingly manufactured in metal, particularly bronze, from the Metal Ages onwards. Sinkers display considerable diversity in both morphology and raw materials, making their classification and chronology particularly complex; this synthesis proposes a broad typo-chronological framework to contextualise their distribution.

Harpoons and tridents occur more sporadically within the archaeological record, while isolated discoveries of fish traps, net fragments and netting shuttles provide evidence for additional fishing technologies that remain comparatively rare.

The poster highlights regional and chronological variations in the representation of fishing equipment. These patterns reveal significant differences in documentation across the



Mediterranean and raise questions concerning the uneven visibility of certain technologies. Particular attention is given to the difficulties associated with identifying some artefacts, including gorges, weights or microliths, whose function as fishing implements is not always straightforward to determine. Differential preservation, depositional processes and the reuse of artefacts further complicate interpretation and contribute to significant disparities in the archaeological visibility of fishing technologies.

This synthesis provides a broad overview of current research and the archaeological evidence available to date. By mapping the distribution of fishing equipment through space and time, it identifies both well-documented areas and major gaps in our knowledge. The poster therefore establishes a framework for future comparative studies and contributes to a better understanding of the diversity and evolution of fishing technologies in the Mediterranean world from Prehistory to Antiquity.

[S3.102-P] -Wednesday, September 30, 2026

The importance of fish diet in Santa Maria di Tergu in northern Sardinia

Barbara Wilkens*

* Freelance researcher

Keywords: Sardinia; Middle Age; marine resources; diversity; Saint Benedict Rule

Abstract: The site now known as Santa Maria di Tergu is located near the coast of northern Sardinia, near present-day Castelsardo. It is known to have been inhabited at least since the late Byzantine period (8th - first half of the 10th century), as a production site. This was later replaced by a residence for wealthy people near to the Judge family (from the second half of the 10th to the mid-11th century). The tendency to exploit fish resources is evident already at this stage, despite the coast being about 7 km away. Interest was primarily focused on sparids and mullets. From the second half of the 11th century and in the following centuries, the site was occupied by a monastic community, and fishing and the exploitation of marine resources increased. The 12th-century levels, which mark the beginning of a new Benedictine monastic phase that lasted until the 13th century, are particularly rich in both the number of fragments and the species represented, indicating an expansion of fishing locations. Both chondrichthyes and osteichthyes, native to rocky and sandy environments, have been identified. As is often the case in Sardinia, freshwater fish are completely absent.

However, the greatest diversity of species, both fish and marine mollusks, can be observed starting from the 12th century. In this case, fish remains rise to 54% of fragments, accompanied by 12% of mollusks, among which limpets predominate. Among fish, mullets predominate, followed by gilt-head bream, but the variety of species and habitats frequented is very wide. Rock fish, seagrass bottom fish, and brackish species still are abundant. Migratory and gregarious fish, such as mackerel and tuna, which may have re-

quired specialized fishing techniques, are absent. The studied remains come largely from kitchen waste.

The Rule of Saint Benedict required abstention from the consumption of quadruped meat, which was given only to the sick. This explains the small quantity and the high quality of caprine and pig meat, largely obtained from young animals. This led to a greater consumption of fish, molluscs, and birds. The monks had two courses at each meal, to which was added, depending on availability, a plate of fruit or legumes. The abbot had a separate table that he shared with guests.

[S3.103-P] -Wednesday, September 30, 2026

Unravelling the role of Atlantic fish in medieval and early modern Western Mediterranean foodways

Arnau Brosa-Planella (1); Laura Llorente (2); Maria Saña Seguí (3); Santiago Riera Mora (1); Arturo Morales Muñoz (4); Krista McGrath (5); André C. Coloneese (5)

(1) Seminari d'Estudis i Recerques Prehistòriques (SERP), Department of History and Archaeology, Universitat de Barcelona, Barcelona, Spain; Institute of Archaeology of the University of Barcelona (IAUB), Barcelona, Spain; (2) Laboratory for Archaeozoological Studies, Faculty of Archaeology, Leiden University, Leiden, The Netherlands; (3) Department of Prehistory, Universitat Autònoma de Barcelona; (4) Laboratorio de Arqueozoología LAZ-UAM, Universidad Autónoma de Madrid; (5) Department of Prehistory and Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona

Keywords: Isotopes; Atlantic fish trade; *Merluccius merluccius*; *Gadus morhua*; Iberian peninsula

Abstract: The expansion of Atlantic fisheries and the circulation of preserved fish products transformed food economies across Europe during the Medieval and Early Modern periods. While documentary and archaeological evidence attest to the importance of these commercial networks, their influence on everyday consumption practices in the western Mediterranean remains insufficiently explored. This is particularly true in the northeast Iberian Peninsula, where the study of archaeological fish remains has received limited attention.

This contribution examines the distribution and consumption of two major Atlantic resources, European hake (*Merluccius merluccius*) and Atlantic cod (*Gadus morhua*), through the integration of archaeological, historical, and stable isotope data. By investigating the provenance and characteristics of fish remains recovered from several sites in northeast Iberia, we assess how imported marine products were incorporated into local food systems between the Medieval and Early Modern periods.

The results indicate that Atlantic fish reached a broad range of social settings and that consumer choices were influenced more strongly by fish size than by species identity or geographic origin. These findings provide a new perspective on the impact of long-distance trade in reshaping past Mediterranean foodways.



[S3.104-P] -Wednesday, September 30, 2026

Fish and military rations during the reign of Louis XIV: an archaeozoological and isotopic analysis of cod remains from Fort Saint-Sébastien (France)

Elise Dufour (1); Benoit Clavel (1)

(1) BioArch – Muséum national d'Histoire naturelle - CNRS Paris, France

Keywords: Cod; Food supply; Fisheries; Isotopes; long distance trade

Abstract: Little documentation exists on the supply of fish in military contexts during the modern era, despite a few normative sources such as the Marquis de Quincy's "Maxims and Instructions on the Art of War" (1726), which explicitly mention cod (*Gadus morhua*), stockfish, and herring (*Clupea harengus*) in the infantryman's rations during days of abstinence in France.

Excavations at Fort Saint-Sébastien, located nearby Saint-Germain-en-Laye (France) and associated with the training campaigns of Louis XIV's elite troops in 1669 - 1670, offer unique archaeozoological insights. Sieving 1,570 liters of sediment through a 1.6 mm mesh yielded 2,236 fish remains (NRd = 12.8%). The remains form an assemblage of 14 species: 6 marine, 1 migratory, and 7 freshwater species. The assemblage reflects a mixed supply system, including fresh local products (freshwater and freshly caught marine species) and preserved fish transported over long distances, with cod dominating with 205 remains.

Analysis of the anatomical composition of the gadids suggests that the cod was decapitated prior to consumption, a practice characteristic of "green" (round) cod prepared aboard Newfoundland vessels. It is evidenced by an abundance of caudal vertebrae, the near-absence of the skull, and traces of decapitation on the cleithra. The large size of the individuals is consistent with a deep-sea supply from the Grand Banks of North America, which at that time accounted for 60% of the tonnage of the French fishery.

Despite the poor state of preservation of the bone collagen, carbon and nitrogen isotope analyses were conducted on cod remains and compared with published reference values for the major Atlantic stocks. The goal is to determine whether cod originated from the seas off northern Europe or the Grand Banks of Newfoundland, and thereby to examine how fish was supplied to the royal troops.

[S4.101-P] -Wednesday, September 30, 2026

A tale of two coastal sites: taxonomy and taphonomy

Irit Zohar (1,2); Ámbar Martínez-Madrid (3); Eufrasia Roselló-Izquierdo (3); Laura Llorente Rodríguez (4); Sonia Pinsky (5,6); Ron Beeri (7); Ayelet Gilboa (5,6); Golan Shalvi (6); Arturo Morales-Muñiz (3)

(1) Department of Biology and Environment, University of Haifa, Oranim, Kiryat Tivon, 3604301, Israel; (2) The Steinhardt Museum of Natural History, Israel National Center

for Biodiversity Studies, Tel Aviv University, 6997801, Israel; (3) Laboratorio de Arqueozoología LAZ-UAM, Universidad Autónoma de Madrid, Madrid 28049, Spain; (4) Laboratory for Archaeozoological Studies, Faculty of Archaeology, Leiden University, Leiden, 2333 CC, The Netherlands; (5) School of Archaeology and Maritime Cultures, University of Haifa, 3498837, Israel; (6) Zinman Institute of Archaeology, University of Haifa 3498837, Israel AG; (7) Israel Antiquity Authority, Jerusalem

Keywords: fish remains; eastern Mediterranean; Southern Levant; Late Bronze Age; Iron Age; Fish trade

Abstract: This study presents preliminary analyses of fish remains recovered from two Levantine sites on the eastern Mediterranean coast: Nahariya (Late Bronze Age, LBA) and Tel Shiqmona* (Iron Age, IA). At Nahariya, a very small sample of 19 fish remains was hand-collected, whereas at Tel Shiqmona fine sieving produced an assemblage of nearly 10,000 specimens.

Taxonomic identification was conducted using the comparative fish collections of the Steinhardt Museum of Natural History at Tel Aviv University (TAU), Israel, and the Archaeozoology Laboratory at the Universidad Autónoma de Madrid (UAM), Spain. At both sites, all remains, including unidentified fragments, were counted and catalogued. Diagnostic elements were measured and digitized, and evidence of cut marks and butchery was recorded.

Rarefaction methods and alpha diversity metrics were applied to assess recovery bias and its effect on species richness estimates.

Preliminary results indicate that while hand-collected samples capture the dominant taxonomic signal, they substantially underrepresent the overall diversity of exploited fish. In contrast, the high-resolution assemblage from Iron Age Tel Shiqmona allows for more detailed reconstructions of maritime practices, diet, and trade networks. Taphonomic analysis further identified evidence for fish processed for delayed consumption (i.e., preservation).

This comparative study demonstrates that fine sieving significantly enhances both the quantity and quality of recovered data, improving reconstructions of past environments, fishing strategies, and commercial networks at coastal sites. Despite methodological limitations, even small hand-collected assemblages from the Late Bronze Age contribute valuable insights into diachronic patterns of fish exploitation along the eastern Mediterranean coast.

* The project of Tel Shiqmona is funded by the Israel Science Foundation (ISF).

[S4.102-P] -Wednesday, September 30, 2026

Minimizing bias during an analysis of fish remains from Kuukpak, an ancestral Inuvialuit site in the Mackenzie Delta, Canada

Suzanne Needs-Howarth (1); Max Friesen (2)

(1) Perca Zooarchaeological Research & The Archaeology Centre, University of Toronto; (2) University of Toronto



Keywords: archaeo-ichthyology; Canadian Arctic; diagnostic elements; Coregoninae; *Lota lota*

Abstract: A recent analysis of faunal material from two houses excavated during the 2014 to 2017 University of Toronto fieldwork at Kuukpak, an ancestral Inuvialuit site in the outer Mackenzie Delta, Canada, ca. 1400–1870 CE, raised the usual questions about what suite of fish skeletal elements to identify in order to minimize bias resulting from differential fragmentation and identifiability. The material was recovered through 3.2 mm mesh dry sieving. The assemblage was dominated by 1) various Salmonidae, with cranial and pectoral girdle bones that are sometimes difficult to identify below family or subfamily and that are relatively fragile; and 2) *Lota lota* (classified as either Lotidae or Gadidae, depending on the authority), with bones that are relatively robust and that can be identified to species by default as it is the only locally occurring representative.

The person performing the identifications (SN-H) had not previously worked with material from such favourable preservation conditions or with *Stenodus leucichthys* (a slightly larger and more robust member of the Salmonidae subfamily Coregoninae than the ones she had previously worked with). After familiarizing herself with the collection, she made a qualitative assessment of relative robusticity and identifiability, including in fragmented condition, and then chose slightly different sets of 30 cranial and pectoral girdle elements to focus on, with each set consisting of those elements that are readily identified to family. She also identified all vertebrae.

We have yet to write up the interpretations. As a preparatory methodological exercise, we 1) discuss how to deal with the quantification effects of having a locally monotypic taxon in the assemblage; and 2) explore what happens to the NISP if the suite of 30 cranial and pectoral girdle elements is narrowed down to various previously published sets of “diagnostic elements” and how this might affect eventual interpretations of fishing and fish preparation and consumption by the occupants of these two houses.

[S4.103-P] -Wednesday, September 30, 2026

The origin and evolution of hake (*Merluccius merluccius*, Linnaeus 1858) exploitation in Iberia, a paleogenomic approach

Rebecca L.S.T. Netels (1); Sónia Gabriel (2); Carlos Fernández-Rodríguez (3); Gloria González-Fortes (4); Rute R. da Fonseca (5); Paula F. Campos (1)

(1) PALEOMAR, CIIMAR – Interdisciplinary Centre of Marine and Environmental Research, University of Porto,

Porto, Portugal; (2) Archaeosciences Laboratory (LARC), Cultural Heritage, P.I. (PC.I.P.), Lisbon, Portugal, (3) Departamento de Historia, Universidade de León, Spain; (4) Instituto Universitario de Xeoloxía (IUX), Universidade da Coruña, A Coruña, Spain; (5) The Globe Institute, Faculty of Health and Medical Sciences, University of Copenhagen, Denmark.

Keywords: European hake (*Merluccius merluccius*); archaeogenomics; ancient DNA; fisheries history; population genomics

Abstract: Marine resources have been intensively exploited for centuries, leading to declines in fish populations and changes in life-history traits. However, the long-term demographic and evolutionary consequences of fishing pressure remain poorly understood, largely because fisheries records rarely extend before the mid-twentieth century. Archaeological fish remains provide a unique opportunity to reconstruct past population dynamics and establish historical baselines relevant for sustainable fisheries management.

This study focuses on the European hake (*Merluccius merluccius*), a commercially important species distributed throughout the northeastern Atlantic, Mediterranean and Black Sea. Despite its current economic significance, hake is rarely identified in archaeological assemblages, partly due to taphonomic biases resulting from the fragility of its skeletal remains and difficulties in species-level identification. Consequently, the extent of hake exploitation before industrial fisheries remains poorly documented.

We aim to investigate temporal changes in hake exploitation and population structure in Iberia using ancient DNA (aDNA).

Archaeological specimens spanning Roman (4th–5th centuries CE), Medieval (12th century CE), and Early Modern (16th–18th centuries CE) contexts will be analysed and compared with modern population data. DNA extracted from archaeological remains will be sequenced and mapped against the recently published chromosome-level hake genome. Population genomic analyses will be used to assess genetic diversity, population continuity, and potential demographic changes through time.

The study will also examine the relationship between historical population structure and present-day fisheries management units.

Current fisheries assessments recognize northern and southern Atlantic stocks, yet previous genetic studies suggest substantial connectivity between these populations. By integrating archaeogenomic and modern genetic data, this project seeks to provide a deeper temporal perspective on hake population history and contribute to evidence-based conservation and fisheries management strategies.



Session 3

Fishing practices, processings and trades

[S3.6-C] -Thursday, October 1, 2026 (09:00)

A 1st century AD amphora filled with fish: the discovery of roman sardines in Gebenstorf, Switzerland

Simone Häberle*

* IPNA, Department of Environmental Science, University of Basel,

Keywords: Roman time; Germania Superior; import; amphora; fishsauce; *Sardina pilchardus*

Abstract: An emergency excavation was carried out last year at Gebenstorf, Switzerland. The settlement is situated on the River Limmat, an important waterway for transport in Roman times and was closely linked to the nearby Vindonissa legionary camp. In the first century AD, a large representative building and a warehouse were built. Several tonnes of amphora sherds were found in rubbish heaps between those stone buildings, including the sherds of a crushed but almost complete amphora with its original fish content: *Sardina pilchardus*, the remains of a roman fish sauce.

The presentation will provide overview of this archaeoichthyological find, discuss the possible origin and nature of the salted fish product, and outline potential avenues for further research in the future.

[S3.7-C] -Thursday, October 1, 2026 (09:20)

Fish consumption at Marinesque roadside relay station in the 1st Century BCE

Ashley Marshall (1); Gaël Piquès (2); Iouri Bermond (3); Delphine Lopez (4); Corinne Sanchez (5);

(1) Université de Montpellier Paul-Valéry, Archéologie des Sociétés Méditerranéennes (ASM, UMR5140); (2) CNRS, Archéologie des Sociétés Méditerranéennes (ASM, UMR5140); (3) Ministère de la Culture, Archéologie des Sociétés Méditerranéennes (ASM, UMR5140); (4) Service d'Archéologie Préventive, Sète Agglopôle Méditerranée; (5) CNRS, Archéologie des Sociétés Méditerranéennes (ASM, UMR5140)

Keywords: archaeo-ichthyology; Late Republic; southern Gaul; roadside relay station; exchange

Abstract: The archaeological site of Marinesque (Loupian, France) was a roadside relay station active during the 1st century BCE.

Made up of sev buildings located on either side of a small intermittent stream, the establishment was intended to accommodate and supply travellers travelling along the Via Domitia. Built by the Romans from 118 BCE onward, this major route connected Italy to the Iberian Peninsula through southern Gaul.

In addition to its location beside a seasonal stream, whose

size and flow varies according to the intense local rainfall events known as Cévenol episodes, the relay station also benefited from the immediate proximity of a vast lagoon that at the time extended as far as the Rhône delta. This environmental context provided favourable conditions for fishing while also placing the establishment in a strategic position for travel and trade thanks to its location along the Via Domitia.

The ichthyofaunal assemblage analysed in this study consists of approximately 540 remains identified at a taxonomical level recovered from various areas of the roadside station. Beyond providing new ichthyofaunal data, still poorly documented for the Late Republican period in southern Gaul, the analysis of fish remains from this particular context makes it possible to characterize both the species consumed and the types of fish products served to travellers and merchants stopping at the establishment.

The results reveal a significant proportion of lagoon species, but above all show a predominance of pelagic fish characteristic of fish sauces and salted fish preparations, particularly the Atlantic chub mackerel (*Scomber colias*). The data therefore points to a mixed supply system, combining local resources obtained through fishing in nearby environments with products that were probably imported. This suggests that the site was both strongly rooted in its immediate environment and integrated into wider exchange networks.

In order to better understand consumption patterns and the exchange networks supplying this roadside relay station, it is necessary to examine the respective roles of local fishing and imported products in provisioning the establishment. It is also important to attempt to identify the origin of these imported products through the correlation of ichthyofaunal and amphora data. This approach is all the more significant given that very little information is currently available concerning the contents of amphorae for the Late Republic period.

[S3.8-C] -Thursday, October 1, 2026 (09:40)

Seafood from the Domitian's square in Ephesos

Alfred Galik*

* Austrian Academy of Sciences, Dominikanerbastei 16, 1010 Vienna

Keywords: Byzantine times; Ephesos; consumption; preserved fish

Abstract: Ephesos is one of the most famous sites in Turkey and it has been investigated by the Austrian Archaeological Institute within the last 130 years. The settling place developed from the Neolithic onwards, over the Bronze Age to a Hellenistic city and finally to a Roman provincial capital. In late antiquity Ephesus became a centre for Christian pilgrimage before the town was slowly abandoned. However, ongoing archaeological research of a business quarter in



Ephesus, which burned down in the early 7th century AD, provide an insight into Byzantine times dietary habits. Rich inventories from a food stall and a storage room next to it is of particular ichthyoarchaeological interest. Finds such as cooking tools or storage vessels have been partly preserved with contents. It allows the reconstruction of food as well as the reconstruction of food preparation in the early 7th century.

Vast numbers of fish and seafood, too, reflect the menu featuring seafood dishes. The preliminary results contribute to a better understanding of everyday life and food habits in the Byzantine Ephesos.

[S3.9-C] -Thursday, October 1, 2026 (10:00)

Medieval bone fishing net weights from Hungary

Kata Szathmári (1,2)

(1) Institute of Archaeology, Research Centre for the Humanities, Eötvös Loránd University (ELTE); (2) Doctoral School of History (Archaeology Program), Faculty of Humanities, Eötvös Loránd University (ELTE)

Keywords: Middle Ages; use-wear analysis; fishing net weights; bone tools; Hungary

Abstract: Bone fishing net weights appear in the archaeological finds of the medieval Kingdom of Hungary. The researchers often confuse them with bone skates due to their similar appearance. In those rare instances where the objects are identified as net weights, they are primarily regarded as “kececsont” (kece bones), based on the work of Ottó Herman. Kece bones are known from ethnographic research as the weights of a fishing net called kuszakece.

During the presented research, I primarily examined objects from the medieval settlement of Ság (Tiszaug – Kis-ér part site), located along the Tisza River, that were considered net weights or skates, as well as a smaller number of bone tools from other sites of Hungary. In the course of the research, I drew on ethnographic parallels to examine the archaeological finds and applied the method of use-wear analysis to both archaeological and ethnographic objects. The use-wear analysis revealed that while the vast majority of the archaeological objects included in this study may actually have been net weights, even though the traces indicate that they were much more likely to have been weights for seine nets. During seine net fishing, the nets move in entirely different directions than kuszakece nets, so the traces may show significant differences and make it possible to distinguish between the weights of the two different net types.

[S3.10-C] -Thursday, October 1, 2026 (10:20)

A cod (*Gadus morhua*) festival in late medieval Bruges (Belgium)

Wim Wouters (1); Jan Huyghe (2); Mathijs Speecke (3); An Lentacker (4); Anton Ervynck (4)

(1) Royal Belgian Institute of Natural Sciences, Brussels, Belgium; (2) Raakvlak, Archaeology, Monuments and Landscapes of Bruges and Hinterland, Belgium; (3) Department of History, Ghent University, Belgium; (4) Independent researchers, Ghent, Belgium

Keywords: Bruges; fish market; cod; fish processing; social status

Abstract: Excavations in the backyard of ‘Huis De Zoppere’, located at Bruges’ Market Square, yielded a large number of fish remains.

The material was recovered from two refuse pits (9 and 14), and was dated to around 1300 AD. At that time, Jan de Zoppere, the owner of the house and its connected plot, was known as a successful fishmonger and an important member of the town’s well-to-do elite.

The fish assemblages from both features, although contemporaneous, show marked differences in composition. The fill of feature 9 was numerically dominated by remains of thornback ray (*Raja clavata*), of which the many spines per fish represent a taphonomic bias when calculating abundance. Other fish species were also recorded but, from an economic perspective, the most important fraction of the assemblage derives from cod, mainly from large individuals (up to 110 cm standard length). Head bones are present, while the caudal vertebrae and the elements of the pectoral girdle are virtually absent. Precaudal vertebrae, their processi and ribs are most abundant within this assemblage.

The fish assemblage from feature 14 was entirely dominated by cod. The skeletal composition is similar to that of feature 9, be it that head bones are now almost completely absent. Both features document a consistent processing pattern in which the precaudal vertebrae were removed at the processing spot while the pectoral girdle and the caudal bones stayed within the product that was sold on the market. Remarkably, feature 9 also contained the bones from the head, thus separated from the marketed part of the fish, while this was not the case in feature 14. Based on the identification of the first six precaudal vertebrae, for feature 9, the MNI exceeds 70 specimens, and this number rises to at least 280 specimens for feature 14. Using estimations of the standard lengths and published length-weight curves, a total weight of almost 500 kg of cod was calculated for feature 9, and no less than 1800 kg for feature 14. To put this into perspective, it must be considered that - before or after the market transaction - the thickest part of the cod fillet was possibly cut away from the vertebral column. A recent experiment with a gutted cod of 6.6 kg showed that the thickest fillet weighs approximately 10% of the gutted cod. In that case, fish processing yielded about 50 kg of fillets in the case of feature 9, and 180 kg for feature 14. These high numbers are unique in Flanders, certainly for this period, and represent an important commodity on the urban market.

Finally, these finds raise the question of the location of the fishing grounds of the cod. It is envisageable that the catch originated from the southern part of the North Sea, most likely during wintertime. The fish was probably gutted and kept in brine at sea, before being cut up at the fishmonger’s workplace.

Isotope analyses (ongoing) will hopefully provide more information on the provenance of the processed fish.



[S3.11-D] -Thursday, October 1, 2026 (11:20)

The evolution of fish chain frame in the northeast of the Iberian Peninsula throughout the medieval and modern periods (7th–18th Centuries)

Arnau Brosa-Planella (1); Maria Saña Seguí (2); Santiago Riera Mora (1); Arturo Morales Muñoz (3)

(1) Seminari d'Estudis i Recerques Prehistòriques, Departament Història i Arqueologia, Universitat de Barcelona Institut d'Arqueologia de la Universitat de Barcelona (IAUB); (2) Departament Prehistòria, Universitat Autònoma de Barcelona; (3) Laboratorio de Arqueozoología LAZ-UAM, Universidad Autónoma de Madrid

Keywords: Ichthyoarchaeological assemblages; Fish chain; Northeastern Iberia; Medieval and Modern periods.

Abstract: Fishing and fish consumption during the medieval and modern periods in the northeast of the Iberian Peninsula (current Catalonia) have historically received little attention from scholars studying the maritime world. Traditional research has heavily prioritized commercial networks, trade routes, and the naval industry, largely overlooking the practical and socioeconomic dynamics of fishing itself. Furthermore, the vast majority of existing studies have been conducted strictly from a historiographical perspective, relying on written records while leaving archaeological data completely absent from the construction of the region's maritime fishing history.

Consequently, the actual practices of fish exploitation, local consumption habits, and the tangible material culture of fishing have remained significantly understudied.

This presentation addresses this research gap by introducing the main results of the first doctoral thesis focused specifically on the ichthyoarchaeological remains of this period and geographic area. Based on the analysis of multiple ichthyoarchaeological assemblages from Catalonia dating from the 7th to the 18th centuries, this study applies the fish chain conceptual framework to offer new socio-historical insights. By analyzing the entire trajectory of the resource—from target environments and capture techniques to processing, commercialization, distribution, and final consumption—this approach reconstructs the complete operational sequence of maritime resources.

The results provide unprecedented data regarding taxonomic representation and the most frequently consumed species, revealing significant shifts in regional preferences over time. Moreover, the data uncovers clear patterns of social differentiation in fish consumption, reflecting how specific species or cuts of fish correlated with socioeconomic status. The study also sheds light on the mechanisms of fish commercialization, preservation methods required for distribution, and the evolution of localized fishing techniques. Finally, by integrating ichthyoarchaeological data with the existing historical narrative, this work contributes to the development of regional historical fishing history and identifies critical future directions for archaeological research.

[S3.12-D] -Thursday, October 1, 2026 (11:40)

Comparative analysis of Pre-Columbian fish butchering: the case of Sueños de Libertad, Colombia

Diana Rocio Carvajal Contreras

Universidad Externado de Colombia. Smithsonian Tropical Research Institute, COIBA AIP

Keywords: fish remains; formative; butchering; Colombia; Caribbean

Abstract: Zooarchaeological analysis of fish remains from the Formative site Sueños de Libertad, near Arjona in northern Colombia, provides evidence of systematic butchering practices. Cut mark distributions, skeletal part frequencies, and breakage patterns indicate standardized processing methods aimed at filleting and portioning members of the Ariidae family. These results align with comparative data from pre-Columbian sites in central Panama, where similar butchering sequences have been documented in fish assemblages. In both regions, consistent disarticulation of cranial and post-cranial elements reflects shared strategies for managing aquatic resources. Taken together, these findings reveal broader regional patterns in subsistence organization during the Formative period. This comparative perspective underscores the value of zooarchaeological data in reconstructing butchering techniques and resource management across northern South America and lower Central America.



Session 4

Methodological and scientific applications

[S4.1-A] -Thursday, October 1, 2026 (12:00)

More adventures in sharkaeology: trace element analysis of the NRD shark vertebrae

Matthew Campbell (1,2); Jingjing Zhang (3); Armagan Sabetian (4)

(1) Anthropology, School of Social Sciences, University of Auckland Waipapa Taumata Rau, New Zealand; (2) CFG Heritage Ltd, Auckland, New Zealand; (3) Bioeconomy Science Institute Maiangi Taiao; (4) School of Science, Auckland University of Technology Te Wānanga Aronui o Tāmaki Makau Rau, New Zealand

Keywords: Shark vertebrae; LA-ICP-MS; New Zealand; Māori

Abstract: A count of 6235 Chondrichthyes vertebrae was recovered from the 17th–18th century AD NRD site (R11/859) on the Manukau Harbour, Auckland, New Zealand. These have been identified by aDNA analysis as mostly rig (*Mustelus lenticulatus*), a Triakidae with a similar life history to school shark. Rig vertebrae are mineralised cartilage that exhibit growth bands in the same that fish otoliths do. As they grow, they incorporate environmental trace elements that can provide insight into nursery habitats, migratory patterns and long-term ecological change. Here we present a preliminary comparative analysis of modern and archaeological triakid vertebrae using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) profiles. Our analyses indicate that distinct nursery habitats and behaviours can be seen in the trace element profiles of the vertebrae, while comparison of the modern and archaeological vertebrae demonstrates the extent of environmental change following modern environmental degradation.

[S4.2-A] -Thursday, October 1, 2026 (12:20)

Unravelling the cause of much chagrin: results of dermal denticle morphology on marine shagreen for insights into historic elasmobranch exploitation

Rachel M. Winter (1); Rikke Beckmann Dahl (2); Erin Dillon (3); Leah Rubin (4,5); Elizabeth C. Sibert (5)

(1) Section for Geobiology, Globe Institute, University of Copenhagen, Copenhagen, Denmark; (2) Natural History Museum of Denmark, Zoological Museum, University of Copenhagen, Copenhagen, Denmark; (3) Smithsonian Tropical Research Institute, Balboa, Republic of Panama; (4) State University of New York College of Environmental Science and Forestry, Syracuse, New York, United States; (5) Department of Geology & Geophysics, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, United States

Keywords: Shagreen; elasmobranch; marine historical ecology;

Abstract: Marine shagreen is a storied, luxury material made from elasmobranch skins, which peaked in popularity in northwestern Europe between the late 17th and early 19th centuries. This material was often used on cases for, or incorporated into, high-value objects (e.g. scientific instruments, eyeglass cases).

Historical records indicate elasmobranch exploitation for shagreen occurred from the Indo-Pacific to Atlantic - encompassing at least 17 species from 13 taxonomic families. Life history traits of many shark and ray species such as slow growth rates and late maturity make them particularly susceptible to the effects of overfishing. Understanding which animals and seas were targeted remains understudied, leaving large gaps in our knowledge of how demand for shagreen impacted historic elasmobranch populations and may be reflected in today's marine ecosystems. Utilising a combination of methodological approaches (dermal denticle analysis, proteomics), we are gaining new insights into elasmobranch exploitation to meet demands for shagreen. This initial work encompasses ~140 objects from Winterthur Museum, M/S Maritime Museum of Denmark, Rijksmuseum, and Rijksmuseum Boerhaave. Dermal denticles, characteristic of many elasmobranchs' skins and of similar composition to teeth, remain preserved to varying degrees on the historic objects.

The morphology of denticles varies between taxa, body location, and ontogeny, making species-level identifications very challenging.

Preliminary analysis of dermal denticle patterns on the objects from Winterthur Museum has been done via comparative morphology and coding of character traits of the denticles using the 'ichthyoliths' R package to assess how much taxonomic identifications can be refined with non-destructive approaches.

Denticle analysis indicates that many of the objects were likely, and unexpectedly, made from the skins of deep-sea species, rather than the shallow-water species suggested by historic sources.

Further refinement of identifications using proteomics will enhance our understanding of which species may have been historically abundant or readily available, thereby revising our historical ecological baselines.

[S4.3-A] -Thursday, October 1, 2026 (12:40)

Ichthyoarchaeological reference collections and their contemporary challenges

Gabriela Prestes Carneiro*

* Museum national d'histoire naturelle, UMR 7209 BioArch - BioArchéologie, Interactions Sociétés Environnements



Keywords: Archaeo-ichthyology; Osteological reference collections

Abstract: Reference osteological collections are an almost indispensable tool for conducting archaeo-ichthyological studies.

Nevertheless, many geographic regions of the world lack such collections, particularly in freshwater basins. This was the case for the Amazon Basin, which, despite being one of the world's largest river basins, did not have fish osteological collections until approximately ten years ago. This situation has been changing with the development of ichthyoarchaeology as a discipline and the establishment of these collections in different regions of the Amazon. In this presentation, we will first discuss the development of ichthyoarchaeology in Brazil and then address the contemporary challenges facing the fish collection of the Muséum national d'Histoire naturelle in Paris. These collections differ in nature (physical and digital collections, articulated and disarticulated skeleton collections, otolith collections, scale collections, etc.) and in their geographic and historical origins: collections derived from former cabinets of curiosities, collections donated by researchers, and collections that are still under development. We will examine the contemporary challenges involved in maintaining these collections: How should they be organized? How can they be made accessible? How can they serve as instruments for advancing ichthyoarchaeology in regions where the discipline does not yet exist?

[S4.4-B] - Thursday, October 1, 2026 (14:40)

Some bones to pick: towards osteological differentiation in four portuguese Mugilid species and size estimation regressions for *Chelon ramada*

Miguel Rodrigues (1); Diogo Dias (2,3); Diogo Ribeiro (2); Mafalda Moncada (2); Beatriz Castro (2); Filipe Ribeiro (2); Sónia Gabriel (4)

(1) UNIARQ - Centre for Archaeology of the University of Lisbon; (2) MARE - Marine and Environmental Sciences Centre / ARNET, Aquatic Research Network, Faculty of Sciences, University of Lisbon, 1749-016 Lisbon, Portugal; (3) CE3C - Centre for Ecology, Evolution and Environmental Changes/Global Change and Sustainability Institute, Faculty of Sciences, University of Lisbon, 1749-016 Lisbon, Portugal; (4) CEAU-FAUP, Centre for Studies in Urbanism and Architecture, Faculty of Architecture, University of Porto

Keywords: Comparative osteology; Mullet; Photographic guide; Regression models; Portugal

Abstract: Mugilidae remains are frequently recovered from Portuguese ichthyoarchaeological assemblages, from both coastal and inland archaeological sites, reflecting the ecological adaptability and migratory behaviour of this family. However, osteological identification to species is often difficult due to morphological closeness of several species and to high species richness.

Consequently, many fish remains are classified to the family level which hampers a better understanding on the specific importance of some species of this family. Presently, this family is constituted by five species in the Portuguese waters, being the most commonly found *Chelon ramada* (thinlip grey mullet), *Chelon auratus* (golden grey mullet), *Chelon labrosus* (thicklip grey mullet), and *Mugil cephalus* (flathead grey mullet).

The aim of the present work is to present skeletal elements that will help the differentiation of Mugilid species, and as well as to present the first data on size estimation models for *Chelon ramada*.

The osteological comparison entails specimens of *Chelon ramada*, *Chelon auratus*, *Chelon labrosus*, and *Mugil cephalus*, that were collected in multiple Portuguese river basins and were processed and deposited on the Laboratório de Arqueociências. (LARC).

The size estimation regression models include *Chelon ramada*, given it is one of the most abundant mullet species in Portugal.

The criteria used for bone selection both for the comparative osteology and the regression models comprised two factors: bone density, as denser bones are more prone to be found in archaeological sites; and presence of elaborate and distinguishable characteristics, since the more defining characteristics a bone has, the better it will be to describe and distinguish from the other species. Following these criteria, 12 bones were chosen from different parts of the cranial and appendicular skeleton (praemaxillare, maxillare, palatinum, dentale, articulare, quadratum, hyomandibulare, urohyale, operculare, interoperculare, posttemporale and cleithrum), and the vertebrae, including the urostale.

For the osteological differences, the preliminary results of the cranial and appendicular bones show a great diagnostic potential as *Chelon labrosus* and *Mugil cephalus* can in most cases be distinguished from the remaining species. Discriminating between *Chelon ramada* and *Chelon auratus* is, however, more challenging, with the most distinguishable bones being the operculare, cleithrum, the articulare and palatinum.

Regarding the vertebral column, the precaudal vertebrae are relatively helpful to distinguish between these species, if the parapophysis and fused haemal arches (in the golden and flathead grey mullets' case) are still intact, whereas differences in the caudal vertebrae, rely more on the patterns of the vertebrae's corpus, which are also susceptible to intra-specific variability.

Regarding the regression models, a total of 34 specimens of *Chelon ramada* with standard lengths between 54 mm and 415 mm, were used for the analyses. Bone measurements were taken with measuring calliper (+0.03mm) and HIROX HRX-01 for the smaller specimens.

The project combines detailed osteological descriptions with a photographic reference guide designed to support taxonomic identification in archaeological assemblages, while also providing regression models for *Chelon ramada*. The resulting framework contributes to improving the interpretation of archaeological fish assemblages and offers new possibilities for investigating past fishing practices, resource exploitation, and human interactions with aquatic environments.



[S4.5-B] -Thursday, October 1, 2026 (15:00)

The Dentine Time Capsule: investigating human–marine interactions through stable isotope analysis of gilthead seabream (*Sparus aurata*) dentine and bone collagen

Laura Llorente Rodríguez (1); Anouk van de Ven (1); Irit Zohar (2,3); Ámbar Martínez-Madrid (4); Eufrosia Roselló-Izquierdo (4); Guy Sisma-Ventura (5); Arturo Morales-Muñiz (4);

(1) Laboratory for Archaeozoological Studies, Faculty of Archaeology, Leiden University, Leiden, 2333 CC, The Netherlands; (2) Department of Biology and Environment, University of Haifa, Oranim, 3604301, Israel; (3) The Steinhart Museum of Natural History, Israel National Center for Biodiversity Studies, Tel Aviv University, 6997801, Israel; (4) Laboratorio de Arqueozoología LAZ-UAM, Universidad Autónoma de Madrid, Madrid 28049, Spain; (5) Israel Oceanographic and Limnological Research, Haifa, 3102201, Israel

Keywords: ichthyoarchaeology; stable isotopes; bone; dentine; *Sparus aurata*

Abstract: Fish bones and teeth are abundant remains in archaeological deposits and provide direct evidence of past aquatic resource exploitation, offering valuable insights into ancient fisheries and aquatic palaeoecologies. In recent years, research on ancient fish exploitation patterns has grown exponentially following the incorporation of biomolecular techniques and stable isotope analyses. These approaches have expanded our ability to investigate environmental changes in aquatic ecosystems, as well as shifts in human palaeodiet, fishing grounds, and trade networks.

Previous studies have examined carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope values in fish muscle tissue, bone, and scales, demonstrating their role as important bioindicators of ecological water conditions and exploited habitats. However, isotopic studies of archaeological fish remains have focused almost exclusively on bone collagen, which reflects long-term averaged dietary and environmental signals across an individual's lifetime. In addition, fast organic diagenesis in fish bones challenges the applicability of these analyses in certain Mediterranean environments and/or very old chronologies.

Because fish continuously replace their teeth, dentine collagen may instead preserve a shorter-term isotopic signal associated with recently exploited habitats and feeding behavior.

Despite this potential, dentine collagen has never been systematically investigated in either modern or archaeological fish remains.

Here, we present the first systematic stable isotope analysis of fish dentine collagen and evaluate its potential as a high-resolution proxy for provenance, seasonality, and fishing practices through the analysis of carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope values in modern and archaeological gilthead seabream (*Sparus aurata*) from the Iberian Peninsula. The isotopic signatures obtained from dentine are directly compared with those derived from bone collagen of the same in-

dividuals. Finally, isotopic results are integrated with fish size data and other archaeozoological evidence to explore diachronic changes in fishing practices and aquatic ecosystems.

[S4.6-B] -Thursday, October 1, 2026 (15:20)

Hidden in the enamel: the contribution of X-Ray Diffraction methodology in understanding fish processing methods

Irit Zohar (1,2); Arturo Morales-Muñiz (3); Jens Najorka (4)

(1) Department of Biology and Environment, University of Haifa, Oranim, Kiryat Tivon, 3604301, Israel; (2) The Steinhart Museum of Natural History, Israel National Center for Biodiversity Studies, Tel Aviv University, 6997801, Israel; (3) Laboratorio de Arqueozoología LAZ-UAM, Universidad Autónoma de Madrid, Madrid 28049, Spain; (4) Department of Core Research Laboratories, The Natural History Museum, Cromwell Rd, London, SW7 5BD UK

Keywords: fish remains; taphonomy; enameloid; X-ray diffraction (XRD) techniques; methodology; cooking

Abstract: The analysis of fish remains recovered from archaeological sites raises several key questions, including past taxonomic composition, fishing methods, agents of deposition, and evidence of butchering and consumption. In recent years, a range of multidisciplinary approaches has been developed to address these issues, including methods for taxonomic identification (e.g., ancient DNA [aDNA], ZooMS), reconstruction of environmental conditions (e.g., isotopic analyses), identification of depositional agents (natural versus cultural), as well as the study of fishing technologies, social complexity, and trade networks.

Although calcined fish remains are often relatively easy to recognize, they provide limited information about culinary practices, instead reflecting disposal into fire, likely after consumption. Consequently, identifying fish cooking process remains a significant challenge for archaeoichthyologists.

In this presentation, we explore the application of X-ray diffraction (XRD) techniques as a tool to investigate thermal alterations of fish remains. XRD enables the characterization of mineralogical changes, particularly variations in crystallite size and structural ordering in both bone apatite and tooth tissues (enameloid and dentine).

We examine the effects of taxonomy, diagenetic processes over time, and thermal exposure on crystallite size (CS) of fish teeth. Our results demonstrate that exposure to high temperatures during burning leads to pronounced crystal growth and increased structural ordering. While burning at temperatures above 500 °C is readily detectable, we found: (a) that enameloid CS differs among taxa, and (b) how to identify subtle changes in enameloid CS associated with lower-temperatures (<250 °C) cooking.

Overall, our findings evidence that XRD provides a valuable complementary approach to reconstruct the thermal history of archaeological fish remains, contributing to a more nuanced understanding of past human behavior related to food processing and disposal.



Special Opening Session

[S0.1-A] -Monday, September 28, 2026 (16:20)

« La pêche est au bout du jardin »: the work of Nathalie Desse-Berset in the early years of archaeo-ichthyology

Tatiana Theodoropoulou*

* Université Côte d'Azur, CNRS, CEPAM, France

Abstract: If the CEPAM laboratory has hosted, since the 1980s, one of the first archaeo-ichthyology units and one of the richest modern fish bone reference collections, it is thanks to the work and dedication of Nathalie Desse-Berset and Jean Desse. Often working together as a couple of archaeo-ichthyologists, Nathalie's contribution remains largely unrecognized. This presentation aims to pay tribute to her as one of the pioneering women in archaeo-ichthyology and member of the FRWG since its beginnings. An adventurous student in archaeology, her meeting with Jean opened the door to the world of archaeo-ichthyology, which she served through numerous projects. She seized the potential of their missions in Europe, Near East, Asia and French Polynesia to collect valuable fish specimens and create one of the largest reference collections of fish, often under particularly hard conditions, especially for women researchers. More than just working in the field, Nathalie has always showed a sharp and particularly sensitive eye for the communities of fishers, men and women, whom she met and worked with over many years. This experience deeply enriched her archaeo-ethnographic approach, resulting in a precious recording of a traditional world of sea labour that is fading away. Back in the lab, she worked for the study numerous assemblages, spanning from the Paleolithic to the early modern periods, and hand-in-hand with Jean they developed methods that now form the core of our discipline. Nathalie was also among the first to apply approaches that were rarely used in archaeo-ichthyology at the time and collaborated in aquatic conservation projects. She passed on her vast knowledge to numerous students that she trained at CEPAM, and continues to transmit and archive her work through her latest publications and documentary film.

[S0.2-A] -Monday, September 28, 2026 (16:40)

To the memory of Knud Rosenlund and Richard Cooke

Arturo Morales-Muñiz (1); Leif Jonsson (2); Irit Zohar (3,4)

(1) Laboratorio de Arqueozoología LAZ-UAM, Universidad Autónoma de Madrid, Madrid 28049, Spain; (2) LJ Osteology, Sweden; (3) Department of Biology and Environment, University of Haifa, Oranim, 3604301, Israel; (4) The Steinhart Museum of Natural History, Israel National Center for Biodiversity Studies, Tel Aviv University, 6997801, Israel

Abstract: Over the past three years, the field of archaeological fish remains research has lost two dear colleagues and leading scholars: Knud Rosenlund and Richard Cooke. From 1968 until his retirement in 2011, Knud Rosenlund served as curator of the Quaternary Zoological Collections from the Zoological Museum of Copenhagen (today a part of the Natural History Museum of Denmark). Knud actively participated in archaeological excavations, being a pioneer of the archaeological fish remains studies and a number of techniques including the digitation of faunal collections. In 1979, he co-authored with one of us (AMM) the first monograph on fish bone measurements.

Two years later, Knud co-hosted a small meeting with ten researchers which became the core of what in 1982, during the 4th ICAZ Conference held in London, became the Fish Remains Working Group (FRWG) that rapidly grew into a large, multidisciplinary and international network encompassing participants from nearly 90 countries.

Richard Cooke, of the Smithsonian Tropical Research Institute (STRI) in Panama, developed an interest in the pre-Columbian history of Panama during his graduate studies in the United Kingdom. He earned his PhD in 1972 with a dissertation on ceramics from archaeological sites in the western Coclé Province of Panama. Following his doctoral research, Richard relocated to Panama, where he became a staff scientist at STRI in 1983.

Although his early work focused on ceramics, Richard cultivated a strong interest in wildlife, particularly faunal remains and exploring the relationships between ancient populations and their environments. He assembled an extensive skeletal collection to support the identification of archaeological fauna from such a rich faunal province. Richard was also instrumental in advancing multidisciplinary approaches in archaeology, integrating ethnography, ecology, ancient DNA (aDNA), isotopes, and other methods.

The contributions of Knud Rosenlund and Richard Cooke to the FRWG and to the broader field of zooarchaeology, though many times overlooked, have been profound both at the level of research and the training of specialists, and cannot be adequately summarized in this presentation.

[S0.3-A] -Monday, September 28, 2026 (17:00)

Haddrah et gargour [images animées]: pêche traditionnelle à Bahrein (CNRS audiovisuel, 1994)

Nathalie Desse-Berset*

* Freelance researcher

Abstract: In Bahrain, the ancient land of Dilmun, fishing has always played a fundamental role, as evidenced by the numerous fish bones uncovered at the archaeological site of Qal'at al-Bahrain. Observing traditional fishing techniques using haddrah or gargour, which are still in use today, pro-



vides additional insight. The island's shallow coasts have favored the use of haddrah —large traps measuring 200 to 400 meters in length— where fish, carried in by the high tide, become trapped as the water recedes.

The species caught, which live on the seabed, are primarily groupers, emperor fish, sea bream, and rabbitfish; these are identical to those identified in archaeological layers dating back to the 4th millennium. However, these traps are gradually being abandoned, as the disruption of the coastal ecosystem (landfill, coral destruction, etc.) has led to a de-

cline in fishing yields.

Fishing with gargour —large basket traps standing 1 to 2.5 meters tall— is increasingly common. Fishing grounds are located about 50 kilometers from the coast, and since gargour are placed in shallow waters, the same species are caught. On the market, the fish sold come exclusively from gargour fishing.

Observing these traditional fishing methods offers valuable information about a heritage that is at risk of disappearing and must urgently be preserved in memory.