

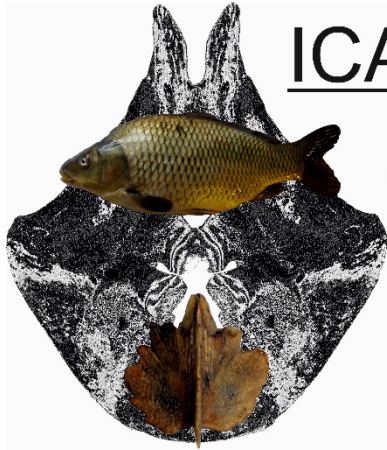


ICAZ FRWG XXI

VIENNA 2022

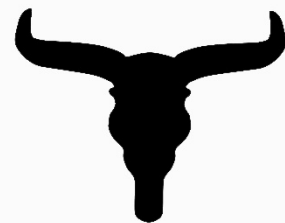


Fish Remains Working Group  
International Council for Archaeozoology



ICAZ FRWG XXI  
VIENNA 2022

Fish Remains Working Group  
International Council for  
Archaeozoology



ICAZ

International Council  
for Archaeozoology

# *ICAZ frwg meeting Vienna*

**22.08. – 27.08.2022**



Österreichisches  
Archäologisches  
Institut

ÖAW



universität  
wien

VIAS

Vienna Institute for Archaeological Science



universität  
wien

Institute for Palaeontology



naturhistorisches  
museum wien





## ICAZ FRWG meeting XXI in Vienna 2022

**Monday – 22.08.2022**

*09:30 am - 10:55 am* – registration

*11:00 am - 11:50 pm* – welcoming

11:00-11:05 Introduction

11:05-11:15 - welcoming words director NHM Vohland Katrin

11:15-11:30 - welcoming words director ÖAI Ladstätter Sabine

11:30 – continuing words

Presentations.

12:00 pm - Ichtyo3D2 : 3D Teleost skeletal database

Dr. Myriam Sternberg

12:20 pm - A Mermaid in the Mediterranean. Studying marine ecosystems, resources and human strategies in Ancient Mediterranean.

Dr. Tatiana Theodoropoulou

12:40 pm - Archaeoichthyological analysis of a residential sector in the Pativilca fishing City of the Caral Civilization.

Prof. Luis Roberto Miranda Muñoz

Chair – David Orton

01:05 pm - 02:05 pm lunch

02:07 pm – video presentation - Ethnoarchaeology in the Canal del Dique (Colombia): Fishing Strategies and Monsú animal resources

Dr. Diana Rocio Carvajal Contreras

02:27 pm - Gathering in the lagoon or sailing away from the coast? Tracking the change in fishing practices in Eastern Arabia during the Prehistory (Diachronic study from 8 archaeological sites in the Sultanate of Oman).

Dr Anaïs Marrast

02:47 pm - Collagen fingerprinting archaeological Caribbean fish bones from the: methodological implications for historical fisheries baselines and anthropogenic change

Dr. Susan deFrance

03:07 pm - Is your river clear? Tracing the quality of freshwater ecosystems in antiquity

Dr Kristine Richter,

Chair – Arturo Morales

**Tuesday – 23.08.2022**

Poster - presentation

The poster presentation on Tu 23rd of August will take place in the Aula/entrance hall of the University building in the Franz-Kleingasse 1, A-1190 Vienna, where the Austrian Archaeological



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



Institute is housed. The presentation starts at 10AM till 12:45PM. The Institute is up the second floor. The University is easy to reach by using the subway U6 and crossing the Währinger Park.

Diagnostic elements for North American Great Lakes fish revisited: A deep dive into the order Perciformes

Dr. Suzanne Needs-Howarth

Fishing in the Early Medieval Slovakia: A Case Study from Bajč

Zora Bielichová

Ancient DNA Analysis of Pacific Cod (*Gadus macrocephalus*) Remains from Hokkaido, Japan

Yuka Shichiza

Marine Archaeozoological Archives (M-ARCHives). A database for Mediterranean marine archaeozoology

Gabriele Carenti

Shrimps in fish sauce? An exceptional discovery of shrimp remains (Crustacea Decapoda) in the archaeological levels of the Roman harbour of Ratiatum (Rezé, Loire-Atlantique, France)

Dr. Aurélia Borvon

The forgotten boxes of Hornstein – a first assessment of fish remains

Dr. Günther Karl Kunst

New coprolites and fish bones from the Ljubljansko barje in Slovenia

Dr. Alfred Galik

Fish and Amphibians from the Neolithic pile-dwelling site Mooswinkel in Lake Mondsee, Austria

MSc Dafni Nikolaidou

Giving fish a dignified funeral? Fish remains uncovered among Late Roman tomb offerings in Northern France

Dr Tarek Oueslati

Specialised settlement - specialised fishery? Preliminary results of the analysed fish bones from the Swiss lake-dwelling site Küssnacht-Immensee (SZ)

Dr. Simone Haerberle

Fish, fishery and urban fish supply of the Viennese Danube in the early modern and modern period

Dr. Gertrud Haidvogel

### 01:00 pm - half-day excursion

14.00 - 14.15: introduction to the *Donauinsel*

14.15 - 15.15: Sterlet-project

15.15 - 16.00: DICCA Projekt

16.00 - 16.30: historical info about the *Donauinsel* in the Inselinfopoint

### Wednesday – 24.08.2022

09:30 am - Atlantic cod in the Medieval and Modern Iberian commercial fisheries

Dr. Laura Llorente-Rodriguez

09:50 am - Introducing the LIFTE project: The zooarchaeology of Orkney, Shetland and the Continent from 1468 to 1712

Dr Jen Harland

10:10 am - Fish trade in the early modern town of Nya Lödöse, Sweden

Emma Maltin

Chair – Richard Hoffmann



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



10:40 am - 11:05 am - coffee-break

11:05 am - Fish consumption and fishing in Puck in the Late Medieval and Early Modern Times

Dr. Anna Gręzak

11:25 am - Fish trade in the Baltic Sea during the early modern period

Dr. Hanna Kivikero

11:45 am - Flatfish and the origins of European marine fishing

Katrien Dierickx

12:10 pm - 01:05 pm lunch

01:05 pm - A Review of Mediaeval Salmonid Bone from the North Sea Basin Area

Liz M. Quinlan

01:25 pm - Unexpectedly small tuna (*Thunnus thynnus*) in Middle Neolithic sites in western Sweden

Leif Jonsson

01:45 pm - Skeletal measurements of northern pike (*Esox lucius* Linné, 1758)

Dr. László Bartosiewicz

02:05 pm - Cod Almighty: Osteometric Models and the Medieval Sea Fishing Revolution

Rachel Blevis

02:30 pm - 02:55 pm coffee-break

02:55 pm - A novel Machine Learning algorithm for the identification of ancient fish remains

Andrew Baker

03:15 pm – Understanding the Dynamics of 19<sup>th</sup> Century Chinese Shark Fisheries in Northern California through Ancient DNA Analysis

Dr. Thomas C. A. Royle

Chair - Eric Guiry

**Conference Dinner - 6:00 PM - 9:00 PM in the Upper Dome Hall of the NHM.**

**Thursday – 25.08.2022**

09:30 am - Fish-eating steppe warriors? Diet reconstruction based on stable isotopic data of human and animal bones from the Middle Avar Period graves in Podersdorf am See (Burgenland, Austria)

Dr. Konstantina Saliari

09:50 am - Sulfur isotopes as an indicator of wetland use

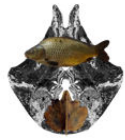
Dr. Eric Guiry

10:10 am - The dynamics of fish supply in late-nineteenth-century New Orleans, Louisiana, USA, and some implications for the role of transportation technologies in fish trade

Dr. Ryan Kennedy

Chair - Tatjana Theodoropolou

10:40 am - 11:05 am coffee break



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



11:05 am - Seafood made of colored stones: a zoo-archaeological analysis of the House of Faun fish mosaic at Pompei

Dr. Dimitra Mylona

11:25 am - Masters of the Levantine Sea: Patterns in fish exploitation during the Iron Age period

Dr. Irit Zohar

11:45 am - On the track of the elusive gilthead seabream (*Sparus aurata*): a preliminary survey of finds in the Mediterranean and Iberian Peninsula

Dr. Arturo Morales-Muñiz

Chair – Alfred Galik

12:10 pm - 01:05 pm lunch

01:05 pm - Fishing the Wine-dark Sea: Diachronic change in marine  $\delta^{13}C$  and  $\delta^{15}N$  values in the Mediterranean

Aurora Allshouse

01:25 pm - When Ichthyoarchaeology is Silent: Signs of Fish Stock Depletion in the Fishing Regulations of the Early Modern Venetian Republic

Daria Ageeva

01:45 pm - Fish consumption at the Abbey of Vendôme (Loir-et-Cher, France)

Dr. Aurélia Borvon

02:05 pm - From estuary to open sea. Fishing grounds exploited by Romans for fish consumption and garum production at Harfleur "Les Coteaux du Calvaire" Seine-Maritime

Dr Tarek Oueslati

02:30 pm - 02:55 pm - coffee-break

02:55 pm - Using 20th century legacy data to look at 21st century questions

Matthew Campbell

03:15 pm - Acquisition and management of marine resources in Fos sur Mer, Provence, France (11<sup>th</sup> to 14<sup>th</sup> century): initial archaeoichthyological results

Tatiana André

Chair – Konstantina Saliari

**Friday – 26.08.2022**

09:30 am The Monk's Last Supper

Zora Bielichová

09:50 am - Fish and Fisheries in medieval Europe: Some observations and research desiderata

Dr. Richard Hoffmann

10:10 am - Witnesses of a cruel death Fishbones from the late medieval site Kipdorp, Antwerpen, Belgium

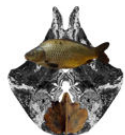
Wim Wouters

Chair - Lembi Lõugas

10:40 am - 11:05 am coffee-break

11:05 am - Fishing during the European Mesolithic: A meta-dataset

Dr. Harry Robson



ICAZ FRWG XXI

VIENNA 2022

Fish Remains Working Group  
International Council for Archaeozoology



11:25 am - Changes in the exploitation and consumption of seafood vs. freshwater resources during the last millennium in Estonia

Prof. Dr. Lembi Lõugas

Chair – Gertrud Haidvogel

12:10 pm - 01:05 pm lunch

01:05 pm - Historical distribution of European sturgeon (*Acipenser sturio*) and Atlantic sturgeon (*Acipenser oxyrinchus*) in Western and Central Europe

Dr. habil. Ulrich Schmölcke

01:25 pm - The results of the study of archaeo-ichthyological materials from the monument of the Scythian time "Konsulovsky settlement" (Zaporozhye region, Ukraine)

Dr. Yevheniia Yanish

02:30 pm - 02:55 pm coffee-break

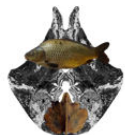
03.00 pm –

closing words

discussion about the venue of the next meeting

trip through the NHMW

end of the Meeting at the NHMW



ICAZ FRWG XXI

VIENNA 2022



Fish Remains Working Group  
International Council for Archaeozoology



### Saturday – 27.08.2022 - Field excursion

Departure on 27th of August at 8:00AM the bus will wait at the side entrance of the Natural History Museum Burgring 7

SchlossORTH Nationalpark-Zentrum Donau Auen, with a guided tour through the exhibition „Donauräume“ and the outdoor area „Schlossinsel“. Bus ride to the parking lots „Uferhaus“ in Orth/Donau followed by a short trip to the Danube with explanations about the Danube, the national park and the national park management (<https://www.donauauen.at/en/visit/schlossorth-national-park-centre>).

Break and trip to Carnutum, an important Roman city at the border of the Roman Empire from the 1st to the 4th century AD. With a military complex and a civil town, it became the capital of the province Upper Pannonia with an estimated population of about 50.000 inhabitants. Visit of the Museum Carnuntinum in Bad Deutsch-Altenburg and the “Roman town quarter” of Carnuntum in Petronell ([https://www.carnuntum.at/en?set\\_language=en](https://www.carnuntum.at/en?set_language=en)).

Bus trip back to Vienna at 6:00 PM

**Abstracts:**

**Monday – 22.08.2022**

**12:00 pm - Ichtyo3D2 : 3D Teleost skeletal database**

Dr. Myriam Sternberg | French National Center for Scientific Research (CNRS) | France

Dr Vladimir Vidal | French National Center for Scientific Research (CNRS) | France

Dr. Daniel Borschneck | French National Center for Scientific Research (CNRS) | France

Camille Tourniaire | Université de Montpellier | France

Vincent Dumas | French National Center for Scientific Research (CNRS) | France

Dr. Stéphanie Satre | French National Center for Scientific Research (CNRS) | France

Dr. Bruno Baudoin | French National Center for Scientific Research (CNRS) | France

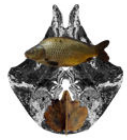
The application of sampling methods with fine sieve meshes during archaeological excavations has considerably modified the image of the role of fishing in the economy of ancient societies. The use of these field techniques allows, by multiplying the data, a quantitative approach that restores the share of each species in consumption, from the smallest to the largest. The millimetre size of certain remains collected in the samples and the numerous similarities between skeletons of individuals of the same genus, or even of the same family, often make the precise identification of small species difficult.

The Ichtyo3D2 project\* is a continuation of a preliminary interdisciplinary project (2021) conducted by CCJ-UMR 7299 and CEREGE, which has experimented the use of 3D x-ray micro-CT (Computed Tomography) on vertebrae of three small teleost bones (*Chelon saliens*, *Diplodus sargus*, *Boops boops*). This technique gives us a high spatial resolution (up to submicron) and access to structural information (bone density, deformation, alteration, etc....). We have information such as bone density, age and season of capture which are difficult to detect in any other way and which are necessary for our studies on the exploitation of fisheries resources over the long term. The three-dimensional x-ray imaging analysis (CEREGE) of various skeleton elements made it possible to create an interactive database. This one will be used, ultimately, as an osteological atlas for various small Mediterranean and Black Sea species. The Centre Camille Jullian has an osteothèque that includes a number of small sparids (*Diplodus sargus*, *Sarpa sarpa*, *Boops boops*, *Lithognathus mormyrus*, *Spicara maena*), small mugilids, labridae (*Coris julis*), serranidae (*Seranus cabrilla*) whose osteology is very poorly known, illustrated and disseminated. Nevertheless, these species appear on the list of species consumed by different communities over time. They characterise the diet of some social categories.

Our objectives with this project are:

- 1) to create a didactic tool for the identification of skeletal elements for any species dedicated to students and researchers interested in the exploitation of marine resources.





ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



- 2) to increase the data sets of interest in several fields of archaeo-ichthyology and more broadly in biology (anatomy, histology of skeletal tissues);
- 3) to characterise the 3D structure (density, shape, porosity, etc.) on various parts of the skeletal elements for the species studied in order to have a better understanding of the conservation parameters of the archaeological remains.

This project will also enable the validation of a high-performance technique for saving and replicating bones, whether they belong to a current repository or come from archaeological sites and if they have to be destroyed to carry out biochemical analyses.

\* The project has received funding from Excellence Initiative of Aix-Marseille University - A\*MIDEX, a French "Investissements d'Avenir" programme - Institute for Mediterranean Archaeology ARKAIA (AMX-19-IET-003).

### **12:20 pm - A Mermaid in the Mediterranean. Studying marine ecosystems, resources and human strategies in Ancient Mediterranean.**

Dr. Tatiana Theodoropoulou | CEPAM Laboratory, CNRS Université Côte d'Azur | France

Introduction. The Mediterranean offers a unique archive of sea-harvesting activities but also the most tangible indicator of past marine ecosystems, i.e., the remains of marine organisms from archaeological excavations. Although archeo- ichthyological and conchyliological studies covering almost all periods of prehistory and antiquity have increased our knowledge of how Mediterranean resources were exploited in various chronocultural and geographical contexts, a more integrated study of marine animal remains may offer a quantitative evaluation of the impacts of environmental and anthropogenic pressures on marine ecosystems and the services resulting therefrom, as well as an appreciation of the resilience of both natural and societal systems.

Objectives. The newly launched ERC-CoG MERMAID proposes a multi-dimensional, long-term study to understand: a) how marine resources have been influenced by environmental pressures, b) when human impact can first be identified in the Mediterranean, and c) the ways ancient populations depended on these resources and adapted exploitation strategies. Results. To support these objectives, MERMAID produces a synthesis of every available dataset, covering several millennia and all Mediterranean biogeographical subdivisions (M-ARCHIVES Database). A combination of approaches (zooarchaeology, marine biology, isotope analysis, fisheries science, ecological modelling, statistics, input of anthropological, geomorphological and palaeoclimatological data) is applied on a critical sample from selected spatiotemporal contexts at a multi-scale resolution. Data on ancient fish catches (archaeo-fisheries archive) are converted into archaeo-ecological data, by exploiting the ecological information provided by archaeofaunal record and by reconstructing ancient marine ecosystems through ecological modelling. Thanks to this approach a reconstruction of ancient baselines through the timespan selected for this project is proposed, that allows to address fluctuations of Mediterranean fisheries (shifting baselines) as well as the nature and degree of the latter. The results are first explored through a climatic perspective, comparing environment-sensitive

markers analysed on fish bones and shells with existing palaeoenvironmental records. Then, the possible impact of these fluctuations on fishing activities is assessed through a quantitative/qualitative appreciation of exploitation strategies in selected contexts. The threshold and degree of human pressure is measured upon a combination of ecological, quantitative and osteometrical data. Finally, the estimation of variations in the presence, frequency or size of marine resources is discussed within both a cultural and an ecological frame.

Conclusions. The results of MERMAID will be key to reconstruct marine ecosystems in the Mediterranean through time, provide evidence of shifting baselines, and assess the nature and degree of adaptations of prehistoric and historical populations to shifting ecosystems. The importance of the project lies in its diachronic and multidisciplinary approach, which combines cross-cutting analytical approaches while addressing major issues in Mediterranean archaeology and historical ecology.

Key words: Mediterranean, marine ecosystems, prehistoric-historical

#### **12:40 pm - Archaeoichthyological analysis of a residential sector in the Pativilca fishing City of the Caral Civilization.**

Prof. Luis Roberto Miranda Muñoz | Universidad Nacional Mayor de San Marcos, Perú

The Áspero archaeological site was initially a fishermen's settlement; later between 3,000 – 1,800 B.C. Its population grew and through the exchange of marine resources for agricultural ones (Supe Valley), it increased its productivity and built its city in front of an old bay, where the marine resource was abundant and its location facilitated fishing. In one of the residential sectors (F – 3), built with stone and plant material, a 1 m hole was recorded in one of the enclosures. In diameter, it contained burned stone material and fish bones. The hole with the stones is the oldest way of cooking food, this is called pachamanca. In the burials recorded in the settlement in males, auditory exostoses have been recorded, indicating that they spent a lot of time diving. In addition, fishing instruments, hooks and fishing nets of different sizes were recorded according to the size of the fish to be caught. These nets are cotton fiber.

**01:05 pm - 02:05 pm lunch**

#### **02:07 pm – video presentation - Ethnoarchaeology in the Canal del Dique (Colombia): Fishing Strategies and Monsú animal resources**

Dr. Diana Rocio Carvajal Contreras | Universidad Externado de Colombia | Colombia

On the Colombian Caribbean Coast, in particular the Canal del Dique region, archaeological evidence dates back to the Formative period (5.000 BP). Samples indicates that shellfish gathering and fishing activities took place in habitats near the coast. The pre-Columbian methods to access these aquatic resources are interpreted from the ethology of collected species and the ethnohistorical information.

There is no archaeological evidence of hooks or other artifacts for the acquisition of these resources. The aim of this presentation is a summary of an ethnoarchaeological study in the districts of Pasacaballos and Leticia near Cartagena (Colombia), contemporary fishing and shellfish gathering from afro- descendant communities are described and this information is compared with fish remains from the Monsú site.

**02:27 pm - Gathering in the lagoon or sailing away from the coast? Tracking the change in fishing practices in Eastern Arabia during the Prehistory (Diachronic study from 8 archaeological sites in the Sultanate of Oman).**

Dr Anaïs Marrast | Muséum National d'Histoire Naturelle (MNHN) | France

Dr Philippe Béarez | Muséum National d'Histoire Naturelle (MNHN) | France

With more than 1300 km of coastline at their disposal, the inhabitants of the Sultanate of Oman turned very early towards the sea and the exploitation of its resources. Indeed, at the beginning of the Holocene, the period was wetter and enabled the development of large mangroves and lagoons, which probably favoured a large occupation of the coastline by human communities. Characterized by numerous shell middens, the local Neolithic (7/6th – 4th millennia) is distinct from the one in the Near East. This regional form was aceramic, without agriculture (with the beginnings of animal husbandry) and accorded great importance to coastal resources.

The mangroves, lagoons and coastlines were heavily exploited before and throughout the Neolithic. This is manifested in the faunal spectra by the presence of thousands of vertebrae of small fish (juveniles, small pelagics) (Natif 2, Ra's al- Hamra 5, 6, Ruways 1, Suwayh 1, Masirah 10) and is complementary to the exploitation of demersal reef fish (Ra's al-Hadd 5, Ra's al-Hamra 5, 6).

However, over time, another type of fishing seemed to gain in importance: the capture of coastal pelagic fish. During the Neolithic period, there was a strong exploitation of jacks and kawakawa. However, tuna fishing became more marked over time. If this is already observed at the Ra's al-Hamra sites, between the 6th and 4th millennia, this trend seemed to become more pronounced in the following period, particularly in view of the results from the Ra's al-Hadd 6 site. Indeed, the climate gradually became aridified, signifying the progressive filling of the lagoons and the end of the mangroves. This period accompanied an expansion of settlement into the interior, a complexification of the social groups, the beginnings of oasis agriculture and copper metallurgy, which transformed fishing gear (copper hooks and no longer mother-of-pearl). In the faunal spectra, this is reflected in an increase in the number of tuna remains (*Thunnus tonggol*, *T. albacares*) and their weights. The abundance of tuna could reflect the improved technology and the greater social cooperation that took place during this period.

Between intensive exploitation of coastal ecosystems and pelagic fishing, what can we learn from the inhabitants of the Middle Holocene through the study of the fish remains and fishing practices? Through a diachronic synthesis of results from 8 coastal sites studied during the last decade, we propose to synthesize our knowledge on the evolution of fishing practices in relation to environmental changes and cultural practices for the studied period.



**02:47 pm - Collagen fingerprinting archaeological Caribbean fish bones from the: methodological implications for historical fisheries baselines and anthropogenic change**

Dr. Susan deFrance | University of Florida | United States

Dr. Virginia Harvey | Palaeome.org

Dr. Michael Buckley | The University of Manchester Manchester | United Kingdom

Dr. Michelle LeFebvre | University of Florida | United States

Dr. Ashley Sharpe | Smithsonian Tropical Research Institute | Panama

Prof. Casper Toftgaard | University of Copenhagen, | Denmark

Dr. Scott Fitzpatrick | University of Oregon | United States

Dr. Christina Giovas | Simon Fraser University | Canada

The Caribbean Sea is the most species-rich sea in the Atlantic due to its vast coral reef systems. However, its high biodiversity and endemism face unprecedented anthropogenic threats, including synergistic modern pressures from overfishing, climate change and bio invasion. Archaeological data indicate initial human settlement of the Caribbean

~7,000 years before present (yr BP), with regionally variable human impacts on fisheries through time based on standard morphological analyses of fish bone. Such studies, however, are challenged by the low taxonomic resolution of archaeological fish bone identifications due to high species diversity in fish families/genera that are morphologically similar. Here, we present collagen fingerprinting (Zooarchaeology by Mass Spectrometry; ZooMS) as a method to overcome to this challenge, applying it to 1,000 archaeological bone specimens identified morphologically as ray-finned fish (Actinopterygii) at 13 Great Caribbean sites spanning ca 1200 BC to AD 1650. The method successfully identified collagen-containing samples (n=720) to family (21%), genus (57%), and species (13%) level. Collagen fingerprinting verified taxonomic identification in 94% of collagen-containing specimens morphologically identified below subclass and, importantly, refined identifications to a lower [more precise] taxon in 45% of these cases; 6% of morphological identifications were incorrect. This study represents the largest application of ZooMS to archaeological fish bone to date and advances future research through the identification of up to 20 collagen biomarkers for 45 taxa in 10 families and two orders. The results indicate that refinement of ZooMS archaeological fish identifications is limited not by the quality of the preserved collagen data but by the available reference collection. More significantly, the relevance of ancient fisheries data to modern sustainability and conservation efforts in the Caribbean is enhanced by high-resolution taxonomic identifications of archaeological bone. This study supports the use of ZooMS on archaeological fish bone samples as an effective biochemical tool available for mass-taxonomic identification of specimens spanning century to millennial time scales in the circum-Caribbean.

**03:07 pm - Is your river clear? Tracing the quality of freshwater ecosystems in antiquity**

Dr Kristine Richter | Harvard University | United States

The first major civilizations were driven by the nature of their local freshwater ecosystems from the Mesopotamian Tigris and Euphrates and the Egyptian Nile to the Yellow River in China, to Lake Texcoco in Mexico. Rivers and lakes continue to provide a source of fresh water for drinking, sanitation, food production, power generation, and manufacturing. While these ecosystems are often more resilient than we give them credit for, they are also highly impacted by anthropogenic and climatic factors which then drive changes in human civilizations both today and in the past. Reconstructing the water quality changes in freshwater ecosystems is important for understanding the past as well as elucidating the factors that contribute to resilience in freshwater management today. This paper explores the roles that identification of fish plays in reconstructing ecosystem quality using improved species level identification through Zooarchaeology by Mass Spectrometry (ZooMS) of cyprinids in Western Europe and the Indian Subcontinent. Then it combines the fish identification with ecological, historical, and archaeological records to identify potential causes and effects of these water quality changes in particular the increasing use of river systems for pre-industrial manufacturing and sanitation.

**Tuesday – 23.08.2022**

**Poster - presentation**

The poster presentation on Tu 23rd of August will take place in the Aula/entrance hall of the University building in the Franz-Kleingasse 1, A-1190 Vienna, where the Austrian Archaeological Institute is housed. The presentation starts at 10AM till 12:45PM. The Institute is up the second floor. The University is easy to reach by using the subway U6 and crossing the Währinger Park.



The Aula/entrance hall



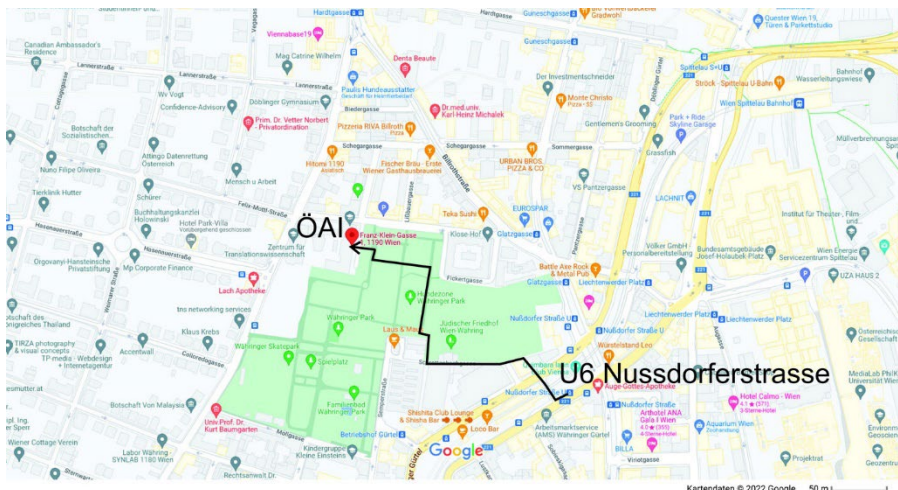
ICAZ FRWG XXI

VIENNA 2022

Fish Remains Working Group  
International Council for Archaeozoology



The Univ./ÖAI



U6 way to the ÖAI

## Diagnostic elements for North American Great Lakes fish revisited: A deep dive into the order Perciformes

Dr. Suzanne Needs-Howarth | Perca Zooarchaeological Research | Canada

Dr. Alicia Hawkins | University of Toronto Mississauga | Canada

Dr. Trevor Orchard | University of Toronto Mississauga | Canada

This poster builds on our research group's previous work on taphonomy, method, and quality assurance with respect to archaeological fish remains from North American Great Lakes watersheds. It was prompted by discussions on identification to different taxonomic levels that we had during our writing up of a recent identification experiment (Hawkins et al. 2022) and by a recent consulting

project in which Suzanne was confronted with more than 3500 bones of the order Perciformes, from a site on the north shore of Lake Erie. This collection included two species from two families she had only rarely encountered in previous analyses (which had related to other watersheds in the Lower Great Lakes region, where these species are uncommon). These two species, coincidentally, have a skeletal morphology that is relatively more robust (*Morone chrysops*, family Moronidae) than the other local species in the order Perciformes or that is highly distinctive in its structure and “architecture” (*Aplodinotus grunniens*, family Sciaenidae). It was already apparent during the analysis itself that the 14 “diagnostic elements” previously defined by her for fish in the Lower Great Lakes region were not evenly represented among species within the order and that certain elements were more likely to be identified to a lower taxonomic level than others. In this poster, we will present a systematic compilation of Perciformes data from this and other sites analyzed by us to evaluate the extent to which element representation varies 1) within the same order within the same site and 2) within the same genus across sites, in order to add further nuance to our quantification of fish bones.

### **Fishing in the Early Medieval Slovakia: A Case Study from Bajč**

Zora Bielichová | Institute of Archaeology of the Slovak Academy of Sciences | Slovakia  
Prof. Dr. Karol Hensel | Faculty of Natural Sciences of the Comenius University | Slovakia

Prof. Dr. Igor V. Askeyev | Biomonitoring Laboratory, Institute of Problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences | Russian Federation

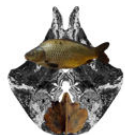
Dilyara N. Shaymuratova | Biomonitoring Laboratory, Institute of Problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences | Russian Federation

Sergey P. Monakhov | Biomonitoring Laboratory, Institute of Problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences | Russian Federation

Dr. Arthur O. Askeyev | Biomonitoring Laboratory, Institute of Problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences | Russian Federation

Matej Ruttkay | Institute of Archaeology of the Slovak Academy of Sciences | Slovakia

The archaeological excavation carried out in Bajč (Komárno District), at the location Medzi kanálmi, uncovered one of the largest early medieval settlements in Slovakia. The site, formerly located on a sand peninsula or an island surrounded by the Žitava River, was explored by the Institute of Archaeology of Slovak Academy of Sciences in 1987–1994. More than five hundred features including sunken huts, exterior clay ovens, storage and roasting pits, channels and human graves were explored. The evaluation of artefacts attests the long-term occupation of the site (6/7th–10/11th c. AD) and its rural character. The bone analysis shows that the local (Slavonic) population exploited a wide range of domestic and wild animals (40 species identified yet). Their subsistence and economy were based on agro-pastoralism with the focus on cultivation of cereals and cattle/caprines herding. Equids, poultry and pigs were of smaller economic importance, although the representation of the first two significantly increased with the time of settlement’s existence. The main shift in the diet and/or herd management occurred in the 9th century AD, when the ageing indicated that the meat exploitation model changed towards the milk/wool oriented husbandry.



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



The lowland setting of the settlement and vicinity of streams, river, bogs and floodplain forests offered plenty of natural resources including aquatic or semi-aquatic taxa such as mammals (*Lutra lutra*, *Castor fiber*), birds (*Asio flammeus*, *Anas querquedula*, *Botaurus stellaris*), terrapins (*Emys orbicularis*), molluscs (*Unio*) and the fishes (*Cyprinus carpio*, *Esox lucius*, *Stizostedion lucioperca*, *Silurus glanis*, *Leuciscus idus*, *Acipenser ruthenus*). Their presence is the direct evidence on fishing and hunting activities of the locals. The question on their role in the subsistence and economy of the early Middle Ages is one of the research goals of the ongoing PhD project aimed at Bajč archaeozoology and the national archaeological project VEGA 2-0083-21 aimed at the study of economic strategies of the medieval and post-medieval communities from archaeological sites in Slovakia. In contrast to the adjacent countries, the fishing subject or the archaeological fish remains stay overlooked by the local researchers. Therefore, our analysis of fish bones and scales from Bajč, complements scarce artefactual evidence and brings the first complex view on the fish exploitation by inhabitants of this part of the Middle Danube area. The taxonomic and element structure of the assemblage, the estimation of fish size and preliminary assessment of the catch season widens our knowledge on fishing and importance of fish within the diet in rural setting of the Early Middle Ages. and. The quality of retrieved information, however, heavily relies upon the field recovery methods used and the preservation of finds.

### **Ancient DNA Analysis of Pacific Cod (*Gadus macrocephalus*) Remains from Hokkaido, Japan**

Yuka Shichiza | Simon Fraser University | Canada

Prof. Dr. Katsunori Takase | Hokkaido University | Japan Dr. Hiroshi Ushiro | Hokkaido Museum | Japan

Christine Conlan | Simon Fraser University | Canada Dr. Hua Zhang | Simon Fraser University | Canada

Dr. Thomas C.A. Royle | Simon Fraser University | Canada

Prof. Dr. Dongya Yang | Simon Fraser University | Canada

Pacific Cod (*Gadus macrocephalus*) is a culturally and economically important taxon in many regions along the North Pacific Rim. Among the Indigenous people of northern Japan -the Ainu- this species was historically an important food stuff and trade good that was exported to mainland Japan. However, relative to salmon, Pacific Cod in Japan has not received much archaeological attention and few ethnographic records discussing the species are available, limiting our understanding of Ainu cod fisheries. In this study, we sought to increase our understanding of Ainu-Pacific Cod interactions by conducting ancient DNA (aDNA) analysis on Pacific Cod remains from ancestral three Ainu sites in Hokkaido (Kaitorima 2, Kafukai 1, and Onkoromanai) dating to the Epi-Jomon (2400 to 2200 cal BP) and Okhotsk (ca. 1600 to 1200 cal BP) periods. To investigate the effects that Ainu and later fisheries had on the Pacific Cod populations we sequenced variable regions of the mitochondrial genome to explore temporal changes in genetic diversity. This study demonstrates how aDNA analysis is a powerful tool for reconstructing fish population history and the effects of fisheries and marine environmental changes.



### **Marine Archaeozoological Archives (M-ARCHives). A database for Mediterranean marine archaeozoology**

Gabriele Carenti | Cepam, CNRS, Université Côte d'Azur, Pôle Universitaire Saint Jean d'Angély 3 | France

Antoine Pasqualini | Cepam, CNRS, Université Côte d'Azur, Pôle Universitaire Saint Jean d'Angély 3 | France

Tatiana Theodoropoulou | Cepam, CNRS, Université Côte d'Azur, Pôle Universitaire Saint Jean d'Angély 3 | France

Introduction: The newly launched ERC-CoG MERMAID project proposes an integrated study to understand the relationship between environmental pressure on marine resources and the impact of human communities on marine ecosystems in the ancient Mediterranean Sea. A multidisciplinary approach is applied to reconstruct past ecosystems, marine resources and their exploitation from the Paleolithic to historical times. Archeo-ichthyological and conchyliological studies have increased in the last decades in the Mediterranean and cover almost all periods of prehistory and antiquity. In this report we present the first task of the project, which consists in the implementation of a database management system (M- ARCHives) designed to store datasets of marine animal remains recovered from archaeological excavations. The importance of the corpus lies in the biogeographical extent and wide chronological span that will allow covering a variety of environmental and socio-economic contexts. The aim is to address environmental and cultural aspects linked to the presence/abundance of species at different scales of resolution.

Results and discussion: Archaeofaunal data selected to address the specific questions of the project are mostly related to taxonomic variability and relative abundances. To this day, M-Archives has processed 200 sites, totalising 280,000 marine remains, of which 38,000 fish bones. In order to discuss our methodological approach as well as constraints, a preliminary view from two geographical areas (Italy and Greece) will be presented. As available data published over the last century are extremely varied and heterogeneous, we would like to discuss frequent problems related to the use of dated literature and heterogeneity of available data due to variable quantification methods, accuracy of taxonomic identification, degree of scholars' expertise, variable editorial rules, or other factors. We will discuss various approaches adopted within the project to provide reliable comparisons. . We will namely present a data-input and statistical protocol regarding quantifications, taxonomical variety and species distribution from the two regions that serves as a standardisation pilot for other datasets. Conclusions: M-ARCHives is the backbone of the MERMAID program. The increasing list of marine faunal studies around the Mediterranean, currently scattered in the scientific and grey literature, calls for a common inventorying of this massive dataset that will allow syntheses on different spatiotemporal scales and targeting different research questions with the aim of following variations in Mediterranean fisheries over the long term. Beyond the aims of the ongoing program, the building of a detailed database of marine data for the Mediterranean will stand individually as the first consultable Database on marine resources and fishing in the Mediterranean past to serve zooarchaeologists, archaeologists or marine historical ecologists. M-



ARCHives also aspires to trigger new discussions between scholars about publishing rules and data sharing in zooarchaeology.

### **Shrimps in fish sauce? An exceptional discovery of shrimp remains (Crustacea Decapoda) in the archaeological levels of the Roman harbour of Ratiatum (Rezé, Loire-Atlantique, France)**

Dr. Aurélie Borvon | CNRS, UMR 7041, Nanterre & ONIRIS (Nantes Atlantic College of Veterinary Medicine, Food Science and Engineering) | France

Dr. Yves Gruet | France

Shrimp remains (Crustacea decapoda) have been discovered in programmed archaeological excavations in the Roman harbour area of Ratiatum (Rezé, Loire-Atlantique, France). Carapace fragments from these small animals can only be detected after careful sieving of the sediment with a 1.1mm square mesh. The discovery of these shrimp fragments is exceptional at an archaeological site; their presence in Ratiatum is explained by the favourable preservation conditions offered by a water-logged environment. Shrimp taxa can be identified by the morphology of different parts of their exoskeleton. Here, the morphology of the rostrum (rigid extension of the head) allowed us to identify *Palaemon longirostris* whilst that of the telson (rear end of the body in arthropods) makes the sand shrimp *Crangon crangon* clearly identifiable. The first species is quite abundant, with more than a hundred specimens; the second is rarer (a few specimens). The ecology of the main species *Palaemon longirostris* indicates that they were caught in an estuary such as that of the Loire. The fact that pieces of shrimp are systematically associated with small fish used in preparing fish sauces suggests that these shrimps were probably also used in this type of preparation. The main aim of this poster is to draw the attention of archaeoichthyologists on this type of neglected remains, and demonstrate that their identification is possible and can provide useful information.

### **The forgotten boxes of Hornstein – a first assessment of fish remains**

Dr. Günther Karl Kunst | University of Vienna (Austria) | Austria

Nikolaus Hofer | Federal Monuments Authority Austria | Austria

At the castle of Hornstein (Burgenland; Eisenstadt-Umgebung), planned scientific excavations were undertaken from 1996- 1998, aiming at various areas of the ruin and the surrounding earthwork. Even though, the documentation and the finds fell into oblivion for over twenty years. Starting in 2019, thanks to an initiative funded by local institutions and the federal monument authority, a re-assessment of the results, both documentation and findings, is taking place.

According to historic sources, the use phase of the castle comprises a comparatively short time span of the late Medieval (14th-15th c.), but an extensive post-medieval secondary use is evidenced by ceramic sherds, along with stray finds from earlier periods. Pottery and animal bones account for most of the finds, which comprises over 100 banana boxes altogether. We are now assessing all find groups provisionally, in order to define future research goals. Since the excavations touched various parts of the castle area, the animal bone assemblages mirror different taphonomic settings. Although

sediments were not dry-sieved or washed, the collecting of animal remains was obviously carried out with great care. Fish bones are present in about 5% of all samples, which are otherwise characterized by domestic mammals and birds and a fairly constant presence of wild mammals. All fish remains other than ribs are photographed in standardized position and then put back into original sample bags, but packed separately. Conceivably, not all specimens are recognized in the course of this superficial screening, and samples are not "depleted" or biased before their proper study. Usually, fish specimens, mostly from medium-sized cyprinids, appear in groups of two or more bones. In some of the smaller samples, fish remains and other microvertebrates may even be dominant, which helps to categorize contexts and eventually prioritize their analysis, along with other find groups.

### **New coprolites and fish bones from the Ljubljansko barje in Slovenia**

Dr. Alfred Galik | Austrian Academy of Sciences | Austrian Archaeological Institute

MSc Dafni Nikolaidou | Austrian Academy of Sciences | Austrian Archaeological Institute

Dr. Tjasa Tolar | Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU)

MSc Nina Caf | Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU) |  
Germany New coprolites and fish bones from the Ljubljansko barje in Slovenia

Recent and new excavations in 2021 at the Neolithic pile-dwelling sites Stare gmajne in the Ljubljansko barje in Slovenia brought frequent ichthyo-archaeological material to light, which are under study in course of an international cooperation project – FWF I 4977 and ARRS J7-1817. At one hand the study on remains out of coprolites can be fortunately continued and on the other hand the intense cooperation between archaeobotany and ichthyo-archaeology enhances now the picture of fish exploitation at the pile-dwelling site, because numerous fish-remains come from the precisely screened finds from the floated and finely sieved archaeobotanical samples.

The coprolites serve as archives for multi-proxy analysis and shed light to human–dog relationship. The content contains various materials such as palynological, palaeoparasitological, archaeobotanical and archaeozoological finds, which are currently studied. Not only the most probably dog coprolites but other archaeological contexts contained various quite small fish remains for instance scales, bones and isolated teeth. The resumption of excavations in the settlement area provides further important information on fishing and fish consumption in the Slovenian Neolithic. The remains prove consumption of Cyprinids, river perch and northern pike and they are mostly composed of rather small and fairly fragmented remains. In addition, the fish remains from the sediment layers within the settlement will provide further important information on fishing and fish consumption in the Slovenian Neolithic.

Keywords:

Neolithic, pile-dwelling, Slovenia, fish

### **Fish and Amphibians from the Neolithic pile-dwelling site Mooswinkel in Lake Mondsee, Austria**

MSc Dafni Nikolaidou | Austrian Academy of Sciences | Austrian Archaeological Institute

Dr. Alfred Galik | Austrian Academy of Sciences | Austrian Archaeological Institute

Mooswinkel is a Neolithic, underwater pile dwelling located in Lake Mondsee, Upper Austria and dates to the 4th millennium BC. Recent excavations were carried out in an interdisciplinary research initiative "Zeitensprung" (Leap in Time). At least three in-situ cultural layers separated by erosional sediment horizons, were recovered, presenting outstanding state of preservation from waterlogged sediments. Therefore, Mooswinkel is offering valuable ichthyo-archaeological material and data for a better understanding of fish exploitation in the first half of the 4th millennium BC. The fish remains, which were carefully selected from the floated and sieved sediment samples are important information sources on fishing and fish consumption of the Neolithic settlers at Lake Mondsee.

The various fish species indicate the repertoire of fishing techniques such as near-shore fishing and net fishing in more open waters. However, in addition to the typical freshwater fish (i.e. cyprinids, northern pike, river perch, brook trout and coregonids) large quantities of mainly frog bones were recognized. More than the fish remains, this raises the question whether the frogs accumulated naturally or reflect part of the inhabitants' nutrition.

Keywords: Austria, ichthyo-archaeology, Neolithic, waterlogged sediment

### **Giving fish a dignified funeral? Fish remains uncovered among Late Roman tomb offerings in Northern France**

Dr Tarek Oueslati | CNRS | France

Dr. Josabeth Millereux Le Bechennec | Direction Maîtrise d'Ouvrage – urbanisme et construction  
AMIENS METROPOLE Samuel Lelarge | Eveha

Excavations of late Roman tombs in Northern Gaul reveal the unusual practice of deposit of whole fish or portions of fish among other offerings including pig, chicken, ceramic and glass vessels. Current knowledge indicates that this practice is specific to the territory of the Amiens as suggested by the discoveries within the necropolis of Amiens (7 on 31 tombs) and Nempont-Saint-Firmin (11 on 83 tombs) and other regional sites already published.

This poster presents the characteristics of the fish documented in Roman tombs. We also seek to give a meaning to the specificities of these funeral rituals in the studied area by taking into account the place of fish in the daily consumption and according to the social and economic changes affecting local populations during the late Empire.

### **Specialised settlement - specialised fishery? Preliminary results of the analysed fish bones from the Swiss lake-dwelling site Küssnacht-Immensee (SZ)**

Dr. Simone Haeberle | Integrative Prehistory and Archeological Science (IPAS), University of Basel | Switzerland

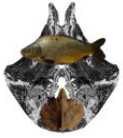
In autumn 2020, a rescue excavation of a newly discovered waterlogged lakeside settlement in Küssnacht-Immensee (SZ) became necessary. The remains of three late Neolithic ("Horgen", Layers 1-3, around 3150-2950 BC) and one end-Neolithic ("Corded Ware", Layer 4, around 2751-2721 BC) settlements were recovered. A notable feature of the site are several middens with layers of ash and fish bones and scales.

It seems that the site of Immensee-Dorfplatz was an important node in the network of the regional supply chains for serpentinite, specialised in the production of semi-finished axe-blades. Probably, it acted on an early stage of the stepwise exchange and fabrication. The surroundings of Immensee are not ideal for Neolithic farming but the local potential for fishery is very high. The question therefore arises, how the economic function of the settlement at Immensee-Dorfplatz is to be understood and what role played fishery in it. Therefore, a first study of the fish bones was made to find clues about the potential "special function" of the settlement.

### **Fish, fishery and urban fish supply of the Viennese Danube in the early modern and modern period**

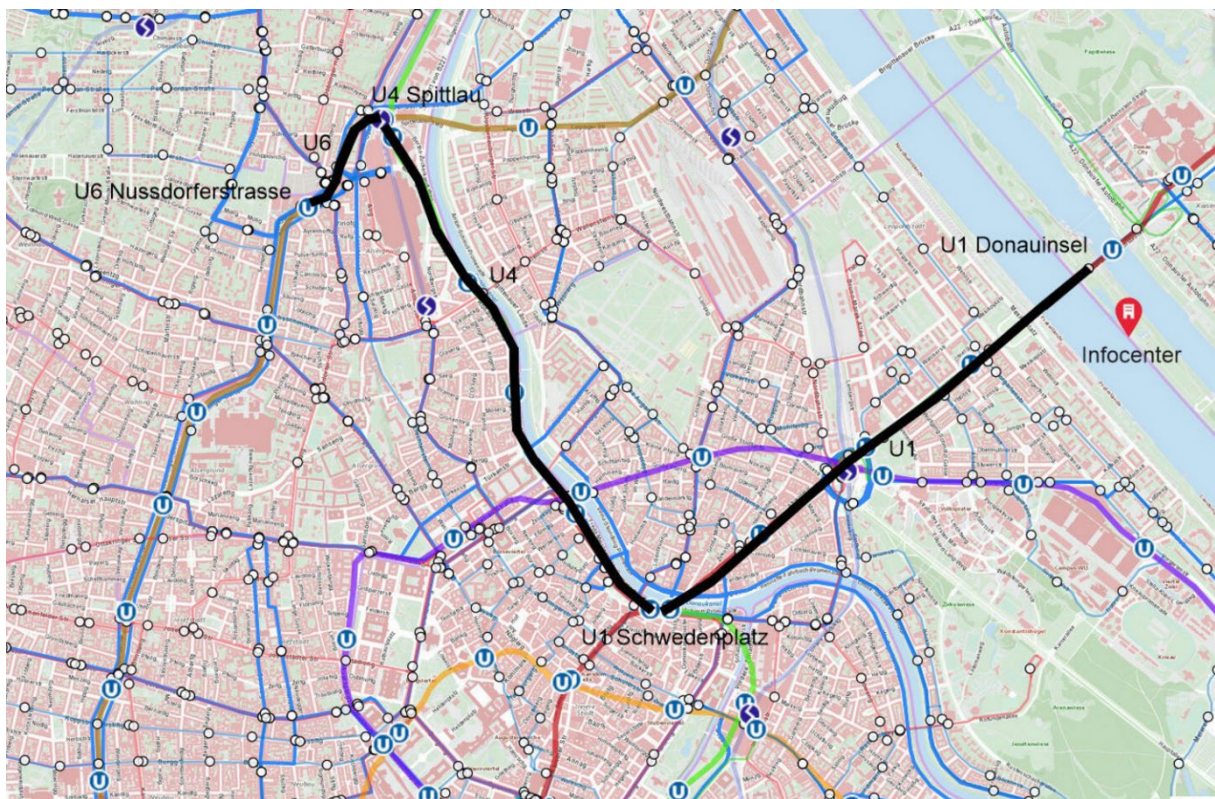
Dr. Gertrud Haidvogel | University of Natural Resources and Life Sciences, Vienna (BOKU) | Austria

The Vienna Danube has a remarkable variety of fish species. One of the earliest historical sources describing a large number of fish offered at the city's fish market is the "Loblied der Stadt Wien" (Appraisal of the City Vienna), published by Wolfgang Schmelzl in 1547. The writer, teacher and clergyman listed more than 30 species. Many can be assumed to have come from local waters, especially the Danube, a major Alpine river that, along with smaller tributaries, provided various services to the city. Several of these uses, such as hydropower generation, transportation or sewage disposal, but also fishing, harmed the fish and their habitats and many were in conflict with fishing. Although no quantitative figures are available, it can be supposed that the fish community of the Vienna Danube changed already in the early modern period. This poster will describe the fish community of the Danube system in and around Vienna in the early modern and modern periods using historical records supplemented by knowledge of local fish remains from the late Middle Ages. It will examine how social uses, as well as hydraulic engineering structures, changed the river and subsequently fish and urban fish consumption.

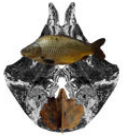


### 01:00 pm - half-day excursion

After the poster presentation a half day excursion on Tu 23rd of August to the “Donau-Insel” is offered taking place at the Info-Center on the Donauinsel (<https://www.wien.info/en/inselinfo-information-center-on-the-danube-island-133004>;  
<https://www.wien.gv.at/umwelt/gewaesser/donauinsel/inselinfo/>;  
<https://www.wien.gv.at/umwelt/gewaesser/donauinsel/pdf/plan-donauinsel.pdf>). Travel will/can be made together by public transport at 1PM departure (take U6 Nussdorferstrasse U4 Spittelau U1 Schwedenplatz – to station U1 Donauinsel; or tram 37, 38 to subway station U2 Schottentor – Praterstern U1 – to station U1 Donauinsel (see Plan). At the Info-Center presentations and information about the history and the function as flood-protection as well as as natural habitat for aquatic organisms of the so-called Donauinsel and the EU-Projects LIFE Sterlet will be provided.



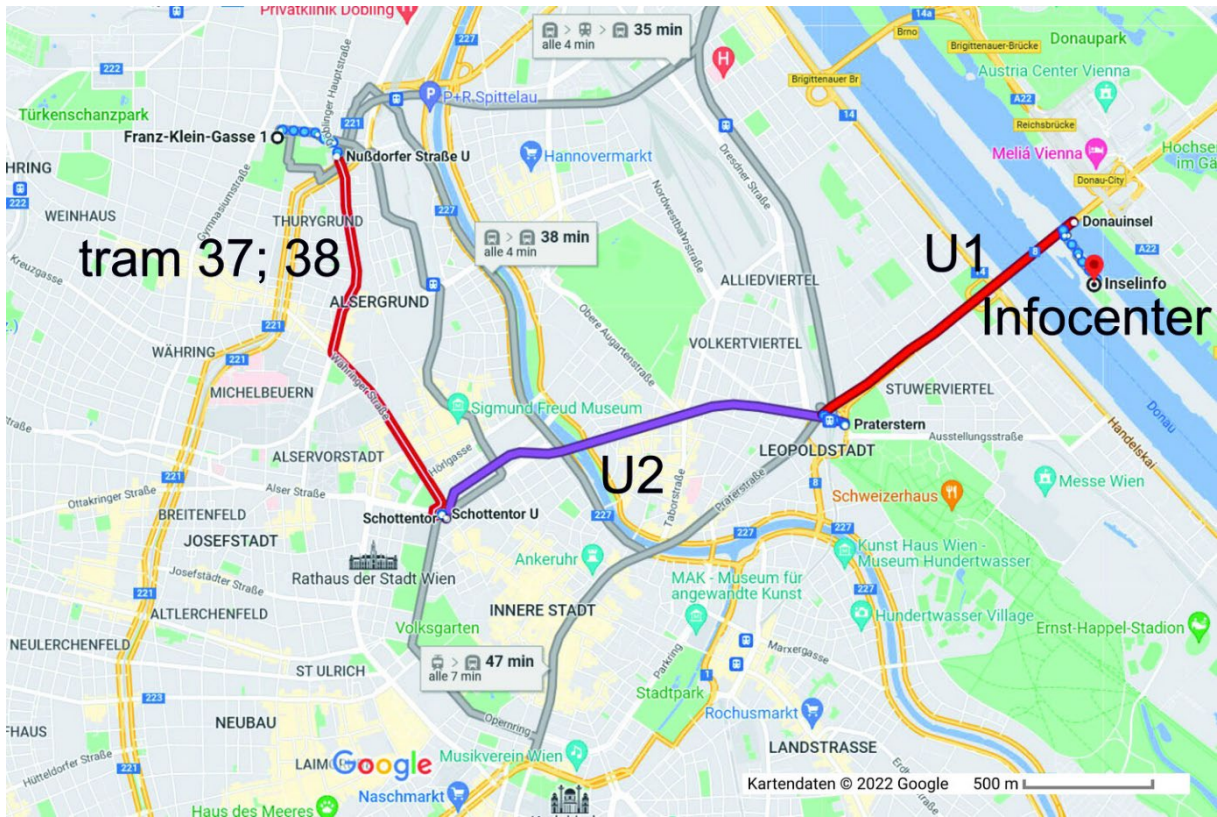
Subway: U6 - U4 - U1



ICAZ FRWG XXI

VIENNA 2022

Fish Remains Working Group  
International Council for Archaeozoology



Tram – subway U2 – U1

**Wednesday – 24.08.2022**

**09:30 am - Atlantic cod in the Medieval and Modern Iberian commercial fisheries**

Dr. Laura Llorente-Rodriguez | Leiden University | Netherlands

Prof. Dr. Arturo Morales-Muñiz | Universidad Autónoma de Madrid. | Spain

Prof. Dr. Juan Antonio Quirós-Castillo | Universidad del País Vasco

Euskal Herriko Unibersitatea | Spain

Dr. Carlos Fernández-Rodríguez | Universidad de León | Spain

Dr. Eduardo González-Gómez de Agüero | Universidad de León | Spain

Dr. Ricard Marlasca-Martín | Posidonia s.l.

Dr. Begoña López-Arias | Autonoma University of Madrid | Spain

Prof. Dr. Oliver Craig | BioArCh-University of York | United Kingdom

Dr. Eufrasia Roselló-Izquierdo | Universidad Autónoma de Madrid. | Spain

During the last decade biogeochemical and biomolecular analyses have helped to elucidate crucial aspects of the medieval and post-medieval NE Atlantic and Baltic cod stockfish trade networks. Although this kind of research is lagging in the southern fringes of Atlantic Europe, northern Iberian fisheries were operating the rich local fishing grounds since early medieval times and expanded into Irish and English waters from the 13th century AD onwards where they also became involved in the trade of preserved cod. Still, it is in the 16th century, when Spanish and Portuguese fleets expanded to the fishing grounds of the New World, that Iberian fish products become relevant items in the profitable cod trade. Iberian written sources testify to the impact of cod commerce in the economy, international relationships, and even culinary practices, yet how this stockfish percolated the Spanish local markets remains an open issue to this day.

To contribute to elucidate these matters in this study we carry out an ichthyoarchaeological survey of Atlantic cod records in Iberia, coupled with a carbon and nitrogen stable isotope analysis from bulk collagen, to trace the geographic origin of cod remains through time. Along with an up-to-date catalogue of archaeological cod finds, the socio-economic contexts of these records, their source, and the price shifts of this stockfish in the Iberian market are discussed, while assessing the accessibility and value of the product to different groups of consumers in Spain from the Middle Ages to Contemporary times.





**09:50 am - Introducing the LIFTE project: The zooarchaeology of Orkney, Shetland and the Continent from 1468 to 1712**

Dr Jen Harland | University of the Highlands and Islands | United Kingdom

LIFTE: Looking in From the Edge is a joint AHRC-DFG project that is examining the archaeological and historical connections joining the Northern Isles of Scotland with the continent during the period of Hanseatic trade, increasing commercialization, and Scottification. This project started in October of 2020 and here, initial results will be presented, focussing on the fish remains. Fishing and agricultural production played a key role in the economies of the islands during this time. Shetland traded fish directly with German markets, while Orkney traded more widely with Norway and mainland Scotland. Post-medieval zooarchaeology has been neglected in our region (and elsewhere) and we will be attempting to fill in the gaps in our understanding, using comparisons with detailed historical accounts, and looking at questions of food preparation, preservation, and trade. We'll be examining how local dietary customs change orientation, from a Scandinavian focus in the 15th century, to an increasing orientation towards Scotland by the end of our period of interest. How do the separate strands of historical and zooarchaeological evidence come together? Are they complementary, or contradictory? The evidence from the Scottish side of the story will be presented here, using frequency density quantification methods, alongside butchery, element patterning and fish sizes to elucidate preservation and trading patterns. Our ongoing excavations at the Viking Age to early modern site of Skail Farm, Rousay, Orkney, have been producing biological material to help fill this chronological gap, and our small-scale excavations in urban Lerwick and Kirkwall have been helping to investigate animal use in the recent past. Here, preliminary results from these excavations will be presented, and our plans for the final years of the LIFTE project will be discussed, including further excavation targeting fish production sites, as well as urban centres of consumption.

**10:10 am - Fish trade in the early modern town of Nya Lödöse, Sweden**

Emma Maltin | Stockholm University, Sweden | Sweden

This paper describes the trade with preserved fish products in the early modern town of Nya Lödöse, Sweden (1473–1624 AD). Large-scale archaeological excavations of the town have yielded an extensive fish bone assemblage, and a multitude of different preserved fish products have been identified in the material. This data is now corroborated by a recent review of customs accounts from the same town, dating to the late 16th century. The customs accounts reveal a thriving trade with fish centred around Kattegat and Skagerrak. Stockfish and herring were important products, but other fish products were also traded in large quantities. Dried and salted flatfish, whiting, haddock, garfish and rays were shipped from Danish towns and fishing villages to Nya Lödöse. Furthermore, prices of different fish products have been compiled and reveal that there were differences in price between different fish products. Information on prices can be used to interpret food waste from different households, and connect certain fish products to class.

**10:40 am - 11:05 am - coffee-break**

### **11:05 am - Fish consumption and fishing in Puck in the Late Medieval and Early Modern Times**

Dr. Anna Gręzak | Faculty of Archaeology, University of Warsaw | Poland

Dr. Urszula Iwaszczuk | Institute of Mediterranean and Oriental Cultures, Polish Academy of Sciences  
| Poland

Puck was a small town situated on the south coast of the Baltic Sea at the mouth of the Płutnica River into the Bay of Puck. Such a localisation was beneficial for fishing and local fish trade. Analysis of food refuse from the city marketplace and the houses in its vicinity, dated to the Late Medieval (late 14th-early 15th century) and Early Modern periods (late 15th- early 16th century), showed the presence of marine, anadromous and freshwater fish. Code was the most frequent fish in the diet of the inhabitants of the town in the whole analysed period. On the other hand, diachronic changes were observed in the fishing and consumption patterns concerning such species as garpike and flatfish. Previous research showed that cod fishery was very intensive during the Late Medieval and Early Modern Times in the region. However, a comparison between the materials from Puck and Gdańsk, a large trade town located at a distance of about 50 km, showed vital differences in the species distribution. This paper aims to discuss the characteristic of fishing and the fish supply at the local market based on the fish remains, archaeological artefacts, and historical sources.

### **11:25 am - Fish trade in the Baltic Sea during the early modern period**

Dr. Hanna Kivikero | Stockholm University | Sweden

The Baltic Sea is one of the largest inland seas with brackish water. The low salinity level has resulted in a blend of both salt water and freshwater species in the Baltic Sea. These marine animal resources have been important for countries and cultures by the Baltic Sea since the Stone Age. There is a long historical continuation for the use of marine animals influenced by e.g., events in history, climate, environment, technical innovations, as well as social development. Large scale fishing and fish trade in the northern part of the Baltic Sea is one of the contributing problems resulting in diminishing fish populations. This study aims to map the traded fish products and their provenance, as well as the extent of fish trade and reactions to possible over-fishing during the early modern period. The study combines zooarchaeological analysis with customs records from ca 1540 to 1640 from modern day Finland and Sweden, as well as laws and ordinances between the 16th and 18th centuries. The two main source materials provide information of the subject from different angles making overall interpretations possible. Preliminary results show that fish products were widely traded in the Baltic Sea. Even though town residents could theoretically fish, most products seem to have been required through trade. Local restrictions to fishing could be possible.

### **11:45 am - Flatfish and the origins of European marine fishing**

Katrien Dierickx | University of York | United Kingdom  
Dr. David Orton | University of York

Dr. Michelle Alexander | University of York

During the Early Medieval Period, most fish consumed in areas around the southern North Sea were taxa which could have been caught in freshwater. From around the 11th century CE, however, significantly more marine species appear in archaeological deposits — the so-called ‘fish event horizon’.

Flatfish are generally regarded as marine species, but some species and juveniles from other species, can also occur in riverine and estuarine environments. Therefore, it is thought that they were amongst the first potentially marine taxa targeted, but so far their role in this economic transition has been unclear due to difficulties in identifying marine vs. estuarine and riverine flatfish. This is partly due to the lack of osteological identification criteria in cranial bones and vertebrae that hinder species identifications, as well as the limited use of stable isotope analysis in these fish remains that would uncover the catch habitat of fish.

To assess the role of flatfish in the fish event horizon, we reconstruct a timeline for the presence and frequency of each species from key sites from around the southern North Sea littoral and explore how flatfish fisheries changed or differed between regions during the Medieval Period. Firstly, flatfish identifications are refined via both morphological methods (comparative osteology and geometric morphometrics), and molecular approaches, with newly developed collagen peptide mass fingerprinting (ZooMS) markers allowing discrimination between 18 flatfish species. Secondly, multi-isotope analysis ( $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ ,  $\delta^{34}\text{S}$ ) is used to infer catch habitat for a large number of fish specimens ( $n=477$ ) from multiple sites ( $n=13$ ) in the southern North Sea area, dated between c. 6th and 16th century CE.

ZooMS identifications reveal a relative decrease of flounder and a slight relative increase in plaice throughout the medieval period across the sites, which is noticed especially in some cities. In other cities flounder remains relatively abundant during the High and Late Medieval periods.

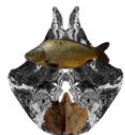
Stable isotope analysis of all archaeological samples show that flounder were captured in both freshwater and marine environments, while plaice seem to have come mostly from marine habitats. No clear transitions are observed between the Early and Late Medieval Periods within either species. Sites show slight differences in  $\delta^{13}\text{C}$  for the same species, which could be related to the local environments or differences in exploitation techniques.

This study represents the first time a multi-disciplinary study of flatfish remains has been used to make species specific interpretations about where and how people exploited flatfish.

The combined morphological and molecular approach provides insight into economic, social and environmental changes in the North Sea area during a key period of economic transition in the medieval period.

**12:10 pm - 01:05 pm lunch**

**01:05 pm - A Review of Mediaeval Salmonid Bone from the North Sea Basin Area**



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



Liz M. Quinlan | University of York | United Kingdom

Prof. James Barrett | Norwegian University of Science & Technology | Norway

Dr. Jennifer Harland | University of the Highlands and Islands | United Kingdom

Inge van der Jagt | Rijksdienst voor het Cultureel Erfgoed | Netherlands

Dr. Anton Ervynck | Vlaams Ministerie van Mobiliteit en Openbare Werken | Belgium

Prof. Anne Karin Hufthammer | Universitetsmuseet i Bergen | Norway

Hans Christian Küchelmann | Knochenarbeit | Germany

Prof. Wim Van Neer | Royal Belgian Institute of Natural Sciences (RBINS) | Belgium

Dr. Michelle Alexander | University of York | United Kingdom

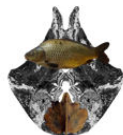
Dr. David Orton | University of York | United Kingdom

The Atlantic salmon (*Salmo salar*) has played various roles in human diet and culture across its range in Northwestern Europe for at least 40,000 years. Literary and documentary sources discussing the use and management of Atlantic salmon are found in legal statutes, tax records, work orders, financial accounts, cookery books, educational texts, and scientific treatises. Despite the apparent popularity and abundance of salmon within the diet, cuisine, and economy of mediaeval NW Europe, the archaeological record does not, at first glance, appear to reflect the same abundance.

Compared to other fish species exploited across the North Sea basin area, relatively few salmonid bones are recovered from archaeological sites— even those sites with otherwise excellent bone preservation. Reviews of mediaeval fisheries report that declines in Atlantic salmon populations were noted by fishers, administrators and mediaeval scholars between the 8th to 14th centuries in North Sea basin countries like France, the Netherlands, and Scotland. In order to address the question of Atlantic salmon presence in the archaeological record, fish bone data was comprehensively reviewed, looking at presence/absence, site types, collection methods, and other metrics. This dataset contains 1270 archaeological contexts, from 410 individual archaeological sites excavated in 8 modern-day European countries, spanning the period from roughly 500-1500AD. In this paper we present the results of our review, tracing the rise and fall of Atlantic salmon presence on archaeological sites and comparing the individual trend in exploitation of this species to overall fishing trends of the mediaeval period. We discuss identification of Atlantic salmon, as well as its place within the proposed 10th-century “fish event horizon” and subsequent observed explosion in marine fish exploitation in much of the study region. Finally, we call for an increase in interdisciplinary study of this key archaeological species, combining biomolecular, zooarchaeological, and historical research to better understand mediaeval fisheries across a wide geographic area.

**01:25 pm - Unexpectedly small tuna (*Thunnus thynnus*) in Middle Neolithic sites in western Sweden**

Leif Jonsson | LJ - Osteology | Sweden



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



Bluefin tuna (*Thunnus thynnus*) is a rare but regular visitor in Swedish waters facing the North Sea. The tuna stock was overexploited in the last fifty years but has started to recover. Today individual fish are tagged and the structure and development of the stock is monitored. The size of tuna in present day North Sea is normally over 2 m and they are sexually mature. Occurrences in the North Sea are concentrated to the second half of the year.

Archaeological finds are spread from Mesolithic to historical times. Here tuna from middle Neolithic sites on the Swedish west coast will be analysed. Two sites have given larger samples. The distribution of sizes does not mirror the distribution of sizes in the natural stock. Reconstructions of sizes rather indicates presence of various size groups.

Rather surprisingly the estimated sizes of the Neolithic fishes shows that the majority are small fishes including fishes under three years and probably immature individuals.

The question then arises if the Bluefin tuna was breeding further north than at present. An example of that is found in the presence of year classes 0+, 1+, 2+ etc among the finds of bogue (*Boops boops*). At the same and contemporary sites we find harp seal and oceanic birds. The picture of a “non-analogue” ecosystem is emerging.

#### **01:45 pm - Skeletal measurements of northern pike (*Esox lucius* Linné, 1758)**

Dr. Łászló Bartosiewicz | Independent Researcher | Sweden

Body length estimations of pike have had a long tradition in archaeoichthyology. However, relationships between measurements need to be further understood. A dozen commonly preserved bone lengths and transversal dimensions were studied on the skeletons of extant pike in Sweden. While traditionally used lengths (e.g. dentale inner length, cleithrum chord length) understandably offer the best estimates of total length, thanks to the growth characteristics of fish, all studied measurements were highly correlated with each other. Univariate parameters of the measurements can also be used in calculating standard (z) scores or variability size indices (VSI) for direct comparisons between fragmented archaeological finds.

#### **02:05 pm - Cod Almighty: Osteometric Models and the Medieval Sea Fishing Revolution**

Rachel Blevis | University of Cambridge | United Kingdom

Prof. Enrico Crema | University of Cambridge

Prof. James Barrett | Norwegian University of Science and Technology

The Atlantic cod (*Gadus morhua*) has been a prominent European trade good from as early as the start of the 11th century CE. The ensuing popularity and energetic exploitation of this species has led to numerous overfishing events and has left modern populations vulnerable to extinctions. The archaeological record continues to assist in the reconstructions of ecological characteristics of such marine populations in the past. These reconstructions are not only pertinent to reconstructions of past overfishing and exploitation patterns, but also to evaluations of modern fish stocks.



Correspondingly, my research utilizes fishbone assemblages, and cod remains in particular, from the 8th-9th century CE site of Lyminge, Kent, to assess the characteristics of fish populations and fishing practices prior to the intensified exploitation of marine resources in England.

The key methods used to assess the shift to intensified marine fishing include the zooarchaeological analysis of the Lyminge assemblage and the development of morphometric parameters and linear regression models that utilize vertebrae measurements.

The developed regression models simplify and refine size estimations of past cod specimens and demonstrate the viability of vertebrae calliper measurements for estimating fish size. Application of the models to the Lyminge remains affirm that captured cod were significantly larger prior to the turn of the millennium. The application of the regression models to the Lyminge cod remains and the reconstruction of the sizes of unimpaired baseline populations holds importance for future plans to protect modern populations and marine habitats.

Finally, the zooarchaeological analysis of the remaining Lyminge fishbones indicate that high proportions of marine fish were consumed on site, in keeping with the observed shift from freshwater to marine fishing in Medieval England.

**02:30 pm - 02:55 pm coffee-break**

**02:55 pm - A novel Machine Learning algorithm for the identification of ancient fish remains**

Andrew Baker | University of Manchester | United Kingdom

Dr. Michael Buckley | University of Manchester | United Kingdom

The identification of ancient fish remains is hindered by various factors, including the richness of taxonomic groups; the distinctiveness of skeletal morphology; the experience level of the analyst; the size of the individual specimens; and whether the analyst had access to comprehensive, well-labelled reference collections. Therefore, biomolecular processes have been increasingly used to assist identification, such as ZooMS—a protein-fingerprint based approach. However, as increasingly large and taxonomically varied datasets are analysed, the confident establishment of biomarkers has become increasingly difficult. Equally, the rapid analysis and identification of such large datasets provides a significant challenge. Machine learning (ML) techniques such as Random Forest algorithms have been considered to expedite the process, however it has proven difficult to identify meaningful biomarkers from this kind of approach. Here we introduce a novel algorithm, built on the principles of entropy and information gain, which can produce comprehensible lists of biomarkers from MALDI spectra, and utilise those biomarkers for high-resolution taxonomic identification of collagen fingerprints produced through ZooMS. This algorithm was applied to datasets of Lithuanian fish at Family level, and Caribbean fish at Genus level, in order to test both the strength of the approach and the maximum taxonomic resolution achievable.

Although there is a slight drop in accuracy at higher taxonomic resolutions, we have shown that ML can produce robust, comprehensible sets of biomarkers which are able to accurately describe a given



taxa. We have also demonstrated its ability to accurately predict the identification of ZooMS collagen fingerprints in fish remains.

**03:15 pm - Understanding the Dynamics of 19th Century Chinese Shark Fisheries in Northern California through Ancient DNA Analysis**

Dr. Thomas C.A. Royle | Simon Fraser University | Canada

Dr. Ryan Kennedy | University of New Orleans | United States

Dr. Eric J. Guiry | University of Leicester | United Kingdom

Luke S. Jackman | Simon Fraser University | Canada

Yuka Shichiza | Simon Fraser University | Canada

Prof. Dongya Y. Yang | Simon Fraser University | Canada

Prior to its destruction in AD 1906, Point Alones in northern California was home to one of the largest Chinese fishing communities in the United States. Established in the mid-19th century, the village served as a base for Chinese fishers operating in Monterey Bay, which was a favoured fishing locale due to its exceptional biodiversity. Excavations of the site have recovered numerous shark vertebrae, indicating they were among the taxonomic groups consistently targeted by Chinese fishers. However, as shark vertebrae are difficult to identify past the family-level using conventional morphology-based approaches, our understanding of the Point Alones shark fishery remains incomplete without additional data. In this study, we sought to address this issue by using ancient DNA analysis to assign species-level identifications to a sample of shark vertebrae from the site. The results of our analysis indicate that tope shark (*Galeorhinus galeus*) was the primary focus of the site's shark fishery, with leopard shark (*Triakis semifasciata*) and brown smooth-hound (*Mustelus henlei*) also being harvested to a lesser extent. All three of these species are typically found near the bottom of waters along the continental shelf, suggesting Chinese fishers were harvesting sharks from these coastal environments. While the tope sharks harvested by the Point Alones fishery were likely being consumed locally, historic records suggest a significant number of fins from the species were also likely being exported to China. Comparisons of the genetic diversity exhibited by the tope sharks identified at Point Alones and modern individuals are also providing insights into this critically endangered species' demographic history. The results of this study also highlight the potential for paleogenetic studies of elasmobranchs, which relative to bony fish have hitherto been the focus of few ancient DNA studies.

**Conference Dinner**

The Conference Dinner will take place in the Natural History Museum Vienna in the Upper Dome Hall ([https://www.nhm-wien.ac.at/en/museum/corporate\\_\\_special\\_events/locations](https://www.nhm-wien.ac.at/en/museum/corporate__special_events/locations)). The dinner will start at the 24th of August at 6:00 PM and will end at 9:00 PM in the Upper Dome Hall.

Thursday – 25.08.2022

**09:30 am - Fish-eating steppe warriors? Diet reconstruction based on stable isotopic data of human and animal bones from the Middle Avar Period graves in Podersdorf am See (Burgenland, Austria)**

Dr. Konstantina Saliari | Naturhistorisches Museum Wien | Austria

Dr. Bendeguz Tobias | Austrian Academy of Sciences

Dr. Erich Draganits | University of Vienna (Austria)

Dr. Karin Wiltschke-Schrotta | Naturhistorisches Museum Wien | Austria

Prof. Dr. Michael Richards | Simon Fraser University | Canada

Systematic excavations at the Middle Avar period cemetery in Podersdorf am See during 2015-2017 documented 45 graves. In order to illuminate aspects of the complex historical processes that took place during this turbulent period, all finds were examined as part of an interdisciplinary project. Collagen carbon, nitrogen and sulphur stable isotope analysis was conducted on 9 human and 14 animal bones to gain more information about the diet of the humans from Podersdorf. The carbon and nitrogen data show that the humans had a diet that was mixed, with protein coming from many sources. Of interest is the more positive  $\delta^{13}C$  values of the humans compared to the cattle and sheep/goat samples. This is likely due to the consumption of the  $C_4$  plant millet. This could be from directly consuming the millet, or from the consumption of animals, especially chickens and perhaps pigs, that were eating millet. Furthermore, the relatively high  $\delta^{15}N$  values of the humans may show a freshwater fish contribution to diets. This interpretation would support previous studies which have shown, that fish played an important role for ancient Central and Inner Asian populations. Taking into consideration the close proximity of Podersdorf to Lake Neusiedl, the largest lake in present-day Austria, and several other smaller shallow lakes nearby, the consumption of freshwater fish should not be unexpected. However, despite sieving of several archaeological sediments, the archaeozoological examination of the faunal remains, revealed no fish bones from the cemetery, and only one fish bone was documented from settlement features (4th to the 6th century AD). Although the absence of fish from the graves is not surprising, since fish finds from early medieval cemeteries are extremely limited, the preliminary results of the isotopic analyses raised several questions regarding factors that influence preservation of fish bones, including taphonomy as well as cultural practices such as food preservation and cooking.

**09:50 am - Sulfur isotopes as an indicator of wetland use**

Dr. Eric Guiry | University of Leicester | United Kingdom Stéphane Noël | Quebec City

John Fowler | St. Mary's University

Ryan Kennedy | University of New Orleans Susan DeFrance | University of Florida





Trevor Orchard | University of Toronto, Mississauga Suzanne Needs-Howarth | Perca  
Zooarchaeology

This paper describes an overlooked dimension of stable sulfur isotope ( $\delta^{34}\text{S}$ ) variation that can reveal new patterns in archaeological human and animal wetland resource use. Sulfur isotope analyses are increasingly becoming a routine part of archaeological research on mobility and diet and, following recent advances in our ability to measure small sample sizes, their use will likely continue to grow. Because the  $\delta^{34}\text{S}$  values of local baselines (from geology and hydrology) are passed on to consumers with little change,  $\delta^{34}\text{S}$  has traditionally been used as a marker for origins and mobility. In addition, the distinctive (often higher)  $\delta^{34}\text{S}$  compositions of sea water means that humans and animals with marine diets or that lived in sea-spray-influenced coastal areas can also be identified. The cycling of sulfur in wetland environments, by contrast, can create a distinctively low  $\delta^{34}\text{S}$  baseline, which is passed on to local biota. Though long acknowledged in the ecological literature for marine settings, this relationship has received almost no archaeological attention. We use case studies on livestock raised in salt marshes and on fish that used a gradient of freshwater wetlands to demonstrate how  $\delta^{34}\text{S}$  can provide a distinctive marker for exploring the cultural and historical ecological dimensions of marine and freshwater wetland use in the past.

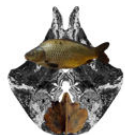
**10:10 am - The dynamics of fish supply in late-nineteenth-century New Orleans, Louisiana, USA, and some implications for the role of transportation technologies in fish trade**

Dr. Ryan Kennedy | University of New Orleans | United States

Dr. Eric Guiry | United Kingdom

Dr. Susan deFrance | United States Dr. Brian Kemp | United States

This paper examines fish supply in late-nineteenth-century New Orleans, Louisiana, USA to understand how rapid changes in fishing and transportation technologies transformed fish trade networks in the Gulf of Mexico and beyond. Fish have played important roles in the food supply and culinary traditions of New Orleans since the city's founding by French colonists in 1718. From the early eighteenth century to the present day, New Orleans' residents have enjoyed access to numerous fish species collected from the Mississippi River and its associated freshwater bayous, the brackish waters of Lake Pontchartrain and Lake Borgne, Southeast Louisiana's barrier islands, and the open waters of the northern Gulf of Mexico. Previous zooarchaeological and stable isotope analyses have demonstrated temporal and geographic shifts in fish supply in the city, including from an eighteenth-century focus on freshwater fishes to increasing usage of brackish water fishes and offshore barrier island fisheries by the early nineteenth century. We build on this previous work by presenting the results of ongoing zooarchaeological, ancient DNA, and stable isotope analyses focused on fish remains from late-nineteenth-century archaeological contexts in the city. The fish species present at multiple sites demonstrate the rapid and extensive appearance of non-local snappers (family Lutjanidae) beginning in the 1860s, as well as the appearance of additional imported taxa, including tilefishes (*Caulolatilus* sp.), Haddock (*Melanogrammus aeglefinus*), and White Hake (*Urophycis tenuis*), by the 1880s. Although the appearance and apparent popularity of these fishes in nineteenth-century New Orleans can be readily explained by rising urban populations



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



and subsequent increased market demand for fish, the trade of these species must also be understood as only being possible through the development and/or widespread adoption of a range of complementary technologies including longline fishing equipment, railroad transport, and artificial ice production. Together, these technologies not only allowed for the shipment of large quantities of fresh fish across vast distances at relatively low cost, but, as suggested by our archaeological data, they also underpinned the development of successive new fisheries such as those targeting Red Snapper (*Lutjanus campechanus*) in the eastern Gulf of Mexico and White Hake in the northwest Atlantic Ocean. Ultimately, we argue that late-nineteenth-century transportation technologies revolutionized the long-distance trade of fresh fish by supporting the transport of these commodities across continental and transnational scales in ways not previously possible.

#### 10:40 am - 11:05 am coffee break

#### 11:05 am - Seafood made of colored stones: a zoo-archaeological analysis of the House of Faun fish mosaic at Pompeii.

Dr. Dimitra Mylona | Institute for Aegean Prehistory - Study Center for East Crete | Greece

Dr. Andrew K.G. Jones | United Kingdom

Seafood representations are undoubtedly among the most attractive and evocative types of evidence on past fishing and fish eating. Yet, art, just like literature and archaeological evidence requires interpretation to become meaningful. This presentation attempts to offer a methodology of doing that, by examining the seafood mosaic scene from the House of Faun in Pompeii.

It uses a contextual approach and multiple scales of analysis, examining the identification, archaeological presence and cultural significance of each of the illustrated fish and molluscs. Which species are present? How are they treated in art? Which of these species were actually consumed in Pompeii according to the ichthyo-archaeological record? What was their monetary value? What was their known cultural value based on written sources? We hope this multidisciplinary analysis may lead to a more nuanced interpretation of both this famous mosaic and the zoo-archaeological record thereby enhancing our understanding of the culture of seafood consumption in 1st CCE Pompeii.

#### 11:25 am - Masters of the Levantine Sea: Patterns in fish exploitation during the Iron Age period

Dr. Irit Zohar<sup>1,2</sup> | University of Haifa | Israel

Dr. Eufrasia Roselló-Izquierdo<sup>3</sup> | Universidad Autónoma de Madrid. | Spain

Prof. Arturo Morales-Muñiz<sup>3</sup> | Universidad Autónoma de Madrid. | Spain

<sup>1</sup>The Steinhardt Museum of Natural History, Tel Aviv University, Israel

<sup>2</sup>Beit Margolin, Oranim Academic College, Kiryat Tivon, Israel. zoharir@gmail.com

<sup>3</sup>Department of Biology, Universidad Autónoma de Madrid, Madrid, Spain arturo.morales@uam.es

Along the Levantine coast, a sharp increase in the number of settlements, and the development of maritime communities, is documented during the earlier phase of the Iron Age period (Ir1a-Ir2a; 1200-900 BCE). In the northern Sinai (Egypt), and the southern coastal plain, the coastal population of the 13th-12th centuries BCE is assigned to immigrants originating from the Aegean (i.e., the 'Sea People', Philistines). Another group of coastal communities, with different cultural attributes, appear along the northern Levantine coast (i.e., Akko, Tyre, Sidon and Byblos), and these are dubbed "Phoenician". The Phoenicians are known to have utilized the sea intensively, both for the production and export of purple dye from the spiny dye-murex (Muricidae), and for maritime trade, reaching the Atlantic Ocean by 900 BC. Surprisingly, research on the association between these Levantine Iron Age coastal communities and the Sea, has been rarely extended to fishing technologies and fish exploitation patterns.

In this study, we address this lacuna by asking how Iron Age communities of the Levantine coast exploited fish. Our null model is that in coastal sites, the fish remains should testify to intensive exploitation of the local littoral fish communities. We test this hypothesis on analyses of a large assemblage of fish remains (>18,000 NISP) from the coastal site of Tel Dor (Israel). The expected taxonomic composition in different habitats along the Levantine coast is calculated from modern data. The fish taxonomic composition, together with oxygen isotope analyses are used as excellent markers of fish habitat and zoogeographic origin, providing new information on ancient maritime trade routes along the Levantine coast.

**11:45 am - On the track of the elusive gilthead seabream (*Sparus aurata*): a preliminary survey of finds in the Mediterranean and Iberian Peninsula**

Prof. Dr. Arturo Morales-Muñiz | Laboratorio de Arqueozoología-Universidad Autónoma de Madrid.  
| Spain

Dr. Irit Zohar | The University of Haifa - Zinman Institute of Archaeology | Israel

Dr. Laura Llorente-Rodríguez | Leiden University-Laboratory for Archaeozoological Studies |  
Netherlands Dr. Leïa Mion | Aix Marseille University / CNRS/ LAMPEA | France

Dr. Carlos Fernández-Rodríguez | Universidad de León | Spain

Dr. Eduardo González-Gómez de Agüero | Universidad de León | Spain

Tatiana André | Aix Marseille University / CNRS/ LA3M | France

Dr. Myriam Sternberg | Aix Marseille University / CNRS/ CCJ | France

Dr. Eufrosia Roselló-Izquierdo | Laboratorio de Arqueozoología-Universidad Autónoma de Madrid. |  
Spain



Since 1980 the gilthead seabream (*Sparus aurata*, L., 1758) constitutes an important fish resource in aquaculture. This can be attributed to the species tolerance to changes in water salinity and temperature, as well as its feeding habits, rapid growth, good taste, and a good market price. From a cultural perspective, one may surmise that the reasons behind the “domestication” of this fish resemble those that brought terrestrial species under human control. To explore the roots and nature of the interaction between past human populations and the gilthead seabream, we here present a preliminary survey of the species presence in the Western Mediterranean and Iberian Peninsula from the Upper Paleolithic until Modern Age times.

The survey evidence that, contrary to our working hypothesis, *S. aurata* happens to be an infrequent find in most archaeological deposits. This pattern agrees with recent fishery reports revealing the rarity of the species in the regions under study. Further investigation on the characteristics of past aquatic habitats exploited by ancient coastal populations, together with ethnographic data on artisanal fisheries, reveal that *S. aurata* is rarely (<0.1%) captured offshore but that intensive exploitations developed on hypersaline, shallow coastal lagoons. Our survey likewise suggests that *S. aurata* remains are more abundant on archaeological sites that were originally located close to coastal lagoons and/or estuaries. This study is set within a broader scope project aimed at exploring the bio-indicator quality of the gilthead seabream to assess the existence and development of coastal lagoons in the ancient Mediterranean and Iberian Peninsula.

KEYWORDS: GILTHEAD SEABREAM, *Sparus aurata*, ARCHAEOLOGICAL FINDS, BIO-INDICATION, COASTAL LAGOONS, MEDITERRANEAN, IBERIAN PENINSULA

**12:10 pm - 01:05 pm lunch**

**01:05 pm - Fishing the Wine-dark Sea: Diachronic change in marine  $\delta^{13}C$  and  $\delta^{15}N$  values in the Mediterranean**

Aurora Allshouse | Harvard University | United States

Dr. Kristine Korzow-Richter | Harvard University

Stable isotope mixing models (simms) have been widely applied to archaeological contexts in recent years, allowing for the reconstruction of complex isoscapes and foodwebs. Applying this method – borrowed from ecology – to archaeological material poses some unique challenges. Using modern individuals for isotopic references can be problematic due to anthropogenic and ecological pressures that have impacted food webs and isotopic values in modern times, and were not present in antiquity. These include factors such as fishing down the foodweb, use of chemical fertilizers, and the burning of fossil fuels. The impact of these pressures on aquatic environments are not always linear or easily predictable, especially at the local level, which poses a significant interpretive challenge to the results generated by simms. Because the accuracy of dietary estimates from simms are reliant on the fundamental assumption that the carbon and nitrogen reference values used are comparable to that of the foods that ancient people would have consumed, it is vital to understand these impacts before making conclusions about ancient diet based on modern proxies. We will discuss the observed



differences between marine carbon and nitrogen values at different trophic levels in the past and present Mediterranean basin and compare these to the published isotopic values of cod in the past and present North Sea. We describe the lack of consistent, correctable offset across trophic level and biogeographical zone, necessitating the determination of local, contemporary carbon and nitrogen reference values for aquatic animals. This is a vital first step not only in reconstructing the diets of ancient peoples, but also understanding the broader implications of modern industrial and agricultural practices on an under-studied marine isoscape.

### **01:25 pm - When Ichthyoarchaeology is Silent: Signs of Fish Stock Depletion in the Fishing Regulations of the Early Modern Venetian Republic**

Daria Ageeva | Central European University | Austria

Fish was a staple food for the population of the Venetian Lagoon marked as such in the very first known mention of Venice by Cassiodorus who described the sixth century Venetians as “gorging themselves with fish” and extracting salt, “instead of driving the plough or wielding the sickle”. Over the centuries, the wealth of the Venetians grew, and their diet became increasingly varied as they pushed the ecological boundaries of natural systems along with their economic expansion. Fish, however, provided an important source of protein for both nobility and popolani throughout Venetian history, especially during Lenten time. The State Archive of Venice is abundant with regulations issued by the Venetian authorities in managing fishing gear and seasons, fishermen’s fraternities, and the fishmongers’ guild. Starting with the sixteenth century, the topos of carestia, hunger, became particularly reinforced in these documents making part of a general growing anxiety over the alluviation of the lagoon, which was believed to be worsened by some of the fishing methods, namely use of reed hurdles (grisiolle). This paper addresses ecological and economic processes whose interplay affected both social and natural environment of the Venice Lagoon. The existent historiography on fishing in Venice is scarce; it is mostly based on contemporarily printed and published material and employs a timeless perspective which disregards changes in the environment of the Venice Lagoon, although picturing the case of the Venetian aquatic source management as an example of pre-modern sustainability. I shall demonstrate, however, that the roots of the overfishing crisis and the disintegration of fishermen’s communities, that in existent historiography is associated with the Habsburgs’ rule, in fact go back to the sixteenth century. Although the ichthyoarchaeological data for this period and location is virtually non-existent, the written sources provide strong evidence to assume that in the 16th-17th centuries the combined effects of the diversion of the Brenta River, recurring plague, the climatic extremes associated with the Little Ice Age, and economic stagnation affected both local environment and life of fishermen’s communities causing its disintegration. Thus, the paper draws upon administrative sources and other written accounts to demonstrate that despite the persistent attempt to restrict juvenile fishing and use of fishing equipment rendered harmful for the fish stock, the sustainable management in pre-modern Venice eventually failed to secure local fish supply under conditions of changing social and natural environment.

### **01:45 pm - Fish consumption at the Abbey of Vendôme (Loir-et-Cher, France)**

Dr. Aurélia Borvon | CNRS, UMR 7041, Nanterre & ONIRIS (Nantes Atlantic College of Veterinary Medicine, Food Science and Engineering) | France

Archaeological excavations carried out in the kitchen of the “Trinité de Vendôme” Abbey (Loir-et-Cher, France) uncovered large quantities of vertebrate remains and among them numerous fish bones. Most remains stem from contexts dated to the 12th-13th centuries. They were recovered by sieving sediment with a 2 mm square mesh. The fish bones were so abundant that it was decided that only a sub-sample of ca. 15,000 bones and ca. 27,000 scales would be studied.

A total of 3,155 bones were identified. Thirteen taxa are present in the assemblage, the first of which is the herring with a little less than 1,800 bones. Numerous remains from freshwater and migratory species are also present, as cyprinids, bullhead, eel and sturgeon constitute the four following species in NISP. Salmonids, pike, perch, loach, stickleback or shad are also represented but by fewer bones. Marine species other than herring are very rare; common mackerel and conger eel are nonetheless identified. When permitted by the NISP, the analysis of body part representation indicates that the remains correlate to food preparation rather than plate waste. The large number of scales also points in this direction.

This study documents the consumption of fish in the monastery, which is dominated in NISP by herring (though probably not in terms of flesh weight) and is characterized by a relatively high taxonomic diversity for an inland site. The demonstrated presence of sturgeon, probably related to the status of the consumers, should also be noted.

### **02:05 pm - From estuary to open sea. Fishing grounds exploited by Romans for fish consumption and garum production at Harfleur "Les Coteaux du Calvaire" Seine-Maritime**

Dr Tarek Oueslati | CNRS | France

Dr Wim Wouters | Royal Belgian Institute of Natural Sciences (RBINS) | Belgium

Dr. Aurélia Borvon | UMR 7041 ArScAn, ONIRIS, GEROM | France

Dr. Yves Gruet | Faculté des Sciences de l'université de Nantes

The question of fishing during Roman times on the Northern shores of Gaul is not well documented partially because of the changes that occurred in sea-levels through time. Rescue excavations during the past ten years in northern France yielded some assemblages, rich in fish bones. Other well sampled sites attest different attitudes towards marine resources or fish in general. The overall picture is that wealthy urban dwellers eagerly consumed fish, oysters, mussels and other molluscs. This is the case for Roman capitals such as Paris, Amiens, Arras, Bavay, and Théroutanne.

Harfleur is a Roman city that produced very large cod and meagre which is very rare on most Roman sites. It also attested two forms of consumption of very small fish. A cesspit which contained an abundance of tiny fish with clear indications of consumption traces. And second, a pit which yielded successive layers of remains of small fishes and shrimps, indicating local manufacture of garum.



These assemblages from Harfleur provide new insights about fishing in Roman times. Comparison with other regional sites enlarge the knowledge of the status of fish during this period.

**02:30 pm - 02:55 pm - coffee-break**

**02:55 pm - Using 20th century legacy data to look at 21st century questions**

Matthew Campbell | CFG Heritage Ltd | New Zealand Prof Melinda Allen | The University of Auckland

Reno Nims | The University of Auckland

Jingjing Zhang | Auckland University of Technology

New Zealand has a long history of scientific engagement with archaeofauna, beginning with the mid-19th century recognition that remains of the extinct moa were frequently associated with Māori occupation sites. However, it was not until the 1960s that archaeologists began to regularly identify fishbone from New Zealand sites, and the 1970s and 80s before a consistent methodology was developed to identify and quantify fishbone. This method relied on identifying five mouth bones considered distinctive to a low taxonomic level (dentary, articular, quadrate, maxilla and premaxilla, along with some 'special' bones), and publishing counts as MNIs. Along with improved methods of bone recovery, researchers have recently begun to identify a much wider range of bones, including vertebrae, and results are more commonly published as NISPs. This has resulted in a wider range of taxa being identified, including small taxa with small mouth bones that preserve poorly; the opportunity to examine differential treatment of body parts; and new understanding of pre-European Māori fishing practices and interactions with their environment. This begs the question, how can the fishbone analyses from the 20th century be used to answer 21st century questions? Here we make some attempt to answer this question, using a variety of quantitative methods to contrast and compare the results from the two analytical methods.

**Friday – 26.08.2022**

**09:30 am The Monk's Last Supper**

Zora Bielichová | Institute of Archaeology at the Slovak Academy of Sciences | Slovakia

Prof. Dr. Igor V. Askeyev | Institute of problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences | Russian Federation

Dilyara N. Shaymuratova | Biomonitoring Laboratory, Institute of Problems in Ecology and Mineral Wealth, Tatarstan Academy of Sciences | Russian Federation

Dr. Marián Samuel | Institute of Archaeology of the Slovak Academy of Sciences | Slovakia

The monastery of St. Joseph in Nitra, on Zobor hill, was established by the bishop and castle captain of Nitra at the end of the 17th century at the location of the former Benedictine monastery of St. Hypolite (9/11th –15th century AD). The hermitage, originally built for 12 monks, came into existence in 1695 or 1697 and represents one of the first five monasteries of the Camaldolese order in the Austrian (Habsburg) monarchy. It was abolished by a decree of Joseph II in 1728.

Several small-scale rescue excavations were carried out at the site. The most systematic was carried out by the Institute of Archaeology of Slovak Academy of Sciences in 2003 and explored the area of a church and monk dwellings. In two of them, the animal bones were uncovered and processed by dry-sieving. Altogether twelve bone samples consisting of 5201 specimens were analysed in 2017. The majority of finds (83%) comes from a small cellar or cesspit in dwelling 9, where bones were deposited together with fine tableware from the final period of the monastery's existence (1760–1782). This material is dominated by aquatic or semi-aquatic taxa including fish (Pisces), European crayfish (*Astacus cf. astacus*), and Eurasian otter (*Lutra lutra*). The most frequent are bones of Northern pike (*Esox lucius*) and common carp (*Cyprinus carpio*). The tench (*Tinca tinca*), common dace (*Leuciscus leuciscus*), common bleak (*Alburnus alburnus*), Wels catfish (*Silurus glanis*), starry sturgeon (*Acipenser stellatus*), Russian sturgeon (*Acipenser gueldenstaedtii*) and the sterlet (*Acipenser ruthenus*) occurred in smaller quantities.

The fish remains are predominated by the large-sized individuals, pointing to the anthropogenic selection of fish, and the wealth of natural resources or favourable artificial fishponds, indicated by several written sources. The representation of skeletal elements from the head, trunk and fin suggest that complete fish were brought to the site. Monks consumed whole or portions of fish in their dishes (traces of butchery and chewing are recorded). The assemblage from dwelling no. 9 had an exclusively fasting character, while dwelling no. 3 yielded (beside the fish, beaver or a terrapin), the bones of domestic mammals including young sheep/goat, young cattle, chicken, goose and turkey. The spatial differences are explained through the context of finds, when in the latter they are related with the construction and destruction of the baroque monastery. The meat of domestic mammals was probably consumed in the monastery by service staff and other secular persons that often visited and used local public services. However, available written records also indicate the relaxation of the diet prescriptions due to the illness or higher age of a monk or the temporal shortage of the fish.

#### **09:50 am - Fish and Fisheries in medieval Europe: Some observations and research desiderata**

Prof. Dr. Richard Hoffmann | York University | Canada

The paper offers an overview of interactions between peoples of western European Christendom and their fishes during the millennium between the dissolution of classical Roman civilization and the arrival of exotic fishes on European markets and European diets about 1500CE. Fisheries are



simultaneously ecological and cultural relationships, not to be understood from single disciplinary perspectives.

Necessary strategies for multi- and interdisciplinary collaboration and a search for consilience are suggested. Approaches combining fish remains, other archaeological finds, and the written record with a grasp of species ecologies sustain themes in the larger story. An initial and regionally long-lasting general ubiquity of subsistence fishing attuned to diverse natural local ecosystems supplied households of all sizes and social ranks. Commercialization spread from the 11th/12th century to insert market exchanges between specialized artisan fishers and local/regional consumers of fish from those same natural systems. Subsequently and incrementally two forms of intensified human colonization of aquatic resources broke the link between consumers and local fish stocks. Artificial fish culture created new domesticated ecosystems for fish of alien origin. Long distance and large-scale commercial fishing at Europe's resource frontiers took fish and preserved them for consumers far away. Both processes played out piecemeal from the 12th century onwards but always regionally and amidst environmental changes of natural and human origin.

Europe's environmental and cultural diversity calls for multi-disciplinary and comparative perspectives on several different research topics where regional societies or social strata made distinctive choices. As time permits approaches are suggested for multi-disciplinary exploration of declines and survival of sturgeon and salmon stocks; the process whereby herring consumption spread from that species' northwestern maritime native range; patterns of consumption of very small fishes, marine and freshwater alike; what happened to carp culture after western landed elites abandoned this production; and the consumption of marine fish in Mediterranean Europe before the arrival of bacalà.

### **10:10 am - Witnesses of a cruel death Fishbones from the late medieval site Kipdorp, Antwerpen, Belgium**

Wim Wouters | Royal Belgian Institute of Natural Sciences (RBINS), Operational Directorate Natural Environments, Brussels, Belgium | Belgium

Wim Van Neer | Royal Belgian Institute of Natural Sciences (RBINS), Operational Directorate Natural Environments, Brussels, Belgium | Belgium

Excavations in Antwerp – Kipdorp revealed a pit with a high concentration of fishbones, dated to the late middle ages. Several skeletons were found in anatomical connection, some were even still covered by skin and scales. A meticulous recovery of articulated remains was impossible from the layer that was approximately 120 cm in diameter and 5 cm deep. A sieved 10 litre sample was studied in the lab and contained tens of thousands of remains from small freshwater fish.

Instead of identifying and quantifying every bone present, the MNI was established. It appears that the pit contained around 3500 individuals, mainly cyprinids. Size reconstructions revealed several year classes and were used to interpret this material. This assemblage, that represents a single depositional event during which fish died as a result of heavy frost, is the first of its kind in Belgium. It can be a useful reference when trying to distinguish natural from anthropogenic deposits.



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



**10:40 am - 11:05 am coffee-break**

**11:05 am - Fishing during the European Mesolithic: A meta-dataset**

Dr. Harry Robson | United Kingdom

Dr. Adam Boethius | Lund University

Dr. Kenneth Ritchie | Moesgaard Museum

Fish played a vital role in the European Mesolithic from its beginnings, as fish remains increased in importance from the relatively sparse evidence seen in the Upper Palaeolithic, to the end stages with the transition to the Neolithic and discussions over the role of aquatic resources in that event. Here, we focus on the European Mesolithic zooarchaeological fish dataset, in which we have collated >650,000 identified fish remains from 446 sites. We aim to document the development of fishing from the early- through middle-Holocene across Europe. While acknowledging certain limitations, for instance preservation and recovery biases, research histories and language constraints, by assembling this comprehensive dataset it is possible to begin to evaluate how fishing developed during the course of the Mesolithic.

Importantly, it is possible to compare and contrast the trajectories evidenced from different areas. The regional transitions from freshwater to marine focused fisheries and the development of distinctive local traditions are highlights of the research. Lastly, since fish likely had significance beyond mere sustenance, such as markers of status and identity, we will discuss the various roles fish played in Mesolithic communities.

**11:25 am - Changes in the exploitation and consumption of seafood vs. freshwater resources during the last millennium in Estonia**

Prof. Dr. Lembi Lõugas | Tallinn University | Estonia

The project 'Foreign vs. local in medieval and modern age foodways in the eastern Baltic: tracing the changing food consumption through provenance analyses' (PRG29), over the past five years, has focused inter alia on the research of the exploitation and consumption of aquatic fauna. There the zooarchaeological analyses shed a light on seafood imports mainly from the North Sea, and showed that both fish and oysters were intensively utilised and traded to the eastern Baltic. In addition to seafood, marine fishing techniques seemed to be also imported at the beginning of the medieval period, since the remains of typical marine fish (e.g. cod, herring, flounder) appear in the Estonian archaeological material of the coastal areas only then. No marine fish were found from the Iron Age material. The studies were also supported by the stable isotope analyses which have established that medieval and early modern human populations in Estonia mostly consumed food of local origin (including freshwater fish). Our research has demonstrated that imported seafood probably formed

an important part of the diet for the upper class (e.g. clergy and noblemen) who also consumed more animal protein in general compared to the lower class.

**12:10 pm - 01:05 pm lunch**

**01:05 pm - Historical distribution of European sturgeon (*Acipenser sturio*) and Atlantic sturgeon (*Acipenser oxyrinchus*) in Western and Central Europe**

Dr. habil. Ulrich Schmölcke | Centre for Baltic and Scandinavian Archaeology (ZBSA) | Germany

Dr. Elena A. Nikulina | Centre for Baltic and Scandinavian Archaeology (ZBSA) | Germany

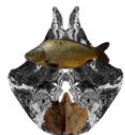
aDNA analyses and morphological investigations of Stone Age to modern sturgeon remains allow a detailed reconstruction of the range history of European sturgeon (*Acipenser sturio*) and Atlantic sturgeon (*Acipenser oxyrinchus*) in western and central Europe. Already during the early Holocene, *A. oxyrinchus* existed in this area. From western France, with decreasing sea level the species spread successively towards the north, reaching the North Sea in mid-Holocene, and migrated in the course of its development into the young Baltic Sea. In contrast, *A. sturio* survived the last Ice Age probably in Iberian waters and dispersed first during the mid-Holocene into the Biscayan. Somewhat later the species reached the southern North Sea, but apart from vagrants it did not occur further north. Only in the last 500 years, after being stable for at least 5000 years, the situation changed significantly, since the European sturgeon spread massively into the North Sea, became the by far dominant sturgeon species there and restricted the Atlantic sturgeon to the Baltic Sea.

**01:25 pm - The results of the study of archaeo-ichthyological materials from the monument of the Scythian time "Konsulovsky settlement" (Zaporozhye region, Ukraine)**

Dr. Yevheniia Yanish | Ukraine

In the course of the study, the remains of 167 fish from the archaeological site of the Konsulovsky settlement (I century BC - II century AD) in the Kherson region were studied. Excavations were carried out in 2016 and 2018 years. All remains of animal origin amounted to 2500 units (mammals, birds, fish, reptiles and mollusks), of which fish - 7.7% of the total sample. All archaeozoological materials are classified as kitchen remains. Representatives of 7 species have been identified: *Cyprinus carpio*, *Rutilus rutilus*, *Abramis brama*, *Rutilus frisii*, *Silurus glanis*, *Esox lucius* and *Sander lucioperca*.

With the exception of *R. frisii* (vyrizub), all identified species belong to the typical modern species of ichthyofauna of small and medium-sized rivers of the Black Sea basin, and are the main industrial species in the study period. The fish were caught near the settlement probably with the help of hooks (catfish and carp) and nets and were not transported over long distances. Carp were harvested during the warm season, and *R. frisii* were caught while moving to spawn.



ICAZ FRWG XXI



Fish Remains Working Group  
International Council for Archaeozoology

VIENNA 2022



In the first place in terms of the absolute number of residues in the material, catfish, in second place are pike perch, pike in third place. In some cases, the age and zoological length of the fish have been reconstructed. Based on the characteristics of the faunal complexes, it was reconstructed that the reservoirs where fish and shellfish were caught had not only areas with a fast current and rocky ground and clear water, but also bays and areas with a slow current and muddy ground.

#### **02:30 pm - 02:55 pm coffee-break**

closing words

discussion about the venue of the next meeting and publication of the meeting

trip through the NHMW

end of the Meeting at the NHMW

#### **Saturday – 27.08.2022 - Field excursion**

Departure on 27th of August at 8:00AM the bus will wait at the side entrance of the Natural History Museum Burgring 7

SchlossORTH Nationalpark-Zentrum Donau Auen, with a guided tour through the exhibition „Donauräume“ and the outdoor area „Schlossinsel“. Bus ride to the parking lots “Uferhaus” in Orth/Donau followed by a short trip to the Danube with explanations about the Danube, the national park and the national park management (<https://www.donauauen.at/en/visit/schlossorth-national-park-centre>).

Break and trip to Carnutum, an important Roman city at the border of the Roman Empire from the 1st to the 4th century AD. With a military complex and a civil town, it became the capital of the province Upper Pannonia with an estimated population of about 50.000 inhabitants. Visit of the Museum Carnuntinum in Bad Deutsch-Altenburg and the “Roman town quarter” of Carnuntum in Petronell ([https://www.carnuntum.at/en?set\\_language=en](https://www.carnuntum.at/en?set_language=en)).

Bus trip back to Vienna at 6:00 PM