ICAZ Marine Mammal Working Group

McDonald Institute for Archaeological Research
20-21 September 2019
PROJECT PROGRAMME

Friday 20th September 2019

9:30 – 10:00  Arrival and registration (Reception at McDonald Institute for Archaeological Research)

Session 1 (McDonald Institute for Archaeological Research seminar room)

10:00 - 10:30  Jacqui Mulville and Sally Evans  Hunting for patterns – Integrating cetacean ZooMS

10:30 – 11:00  Youri van den Hurk  Creation of an osteological reference for cetaceans in archaeology manual

11:00 – 11:30  Tarek Oueslati, Camilla Speller, Krista McGrath, Rémy Blondeau, Patrice Herbin, Gaëtan Jouanin, Tristan Moriceau and Sandie Poisson  Marine mammal evidence from settlements of the French shore of The Channel

11:30 - 11:50  Coffee

Session 2 (McDonald Institute for Archaeological Research seminar room)

11:50 – 12:20  Claire F. MacKay  Early cetacean exploitation: An Orcadian perspective

12:20 – 12:50  Alexandre Lefebvre, J.M. Pétillon, E. Álvarez-Fernández, M. De la Rasilla  The exploitation of cetacean bone by Magdalenian foragers of
12:50 -13:00 Poster introduction: Ruairidh Macleod, Mikkel-Holger S. Sinding, Matthew Collins, Morten Tange Olsen and Steve Rowland

Hydrophobic preservation of DNA in ambergris and implications for whale gut microbiomes

13:00 – 14:00 Lunch and (voluntary) participation in Global Climate Strike

Session 3 (McDonald Institute for Archaeological Research seminar room)

14:00 – 14:30 Richard Sabin

Marine mammals at the Natural History Museum (NHM), London: 250 years of collecting

14:30 – 15:00 Penny Clarke

The UK Antarctic Heritage Trust and conducting whale satellite imagery analysis with the British Antarctic Survey

15:00 – 15:30 Danny Buss

Understanding genetic diversity and foraging differentiation of baleen whales in the South Atlantic prior to 20th Century whaling

15:30-16:00 Coffee
### Session 4 (McDonald Institute for Archaeological Research seminar room)

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10:30 – 11:00 Maiken Hemme Bro-Jørgensen, Hans Ahlgren, Aikaterini Glykou, Morten Tange Olsen and Kerstin Lidén

Exploitation of Baltic seals analysed through ancient DNA

10:30 - 11:00 Coffee

Session 2 (McDonald Institute for Archaeological Research seminar room)

11:00 – 11:30 Matthew Teasdale, Élodie Lévêque, Sarah Fiddyment, Maiken Hemme Bro-Jørgense, Morten Tange Olsen and Matthew Collins

Hiding in plain sight: The biomolecular identification of pinniped use in medieval manuscripts


Intra- and inter-tooth variation in strontium isotope ratios from prehistoric seals by laser ablation (LA)-MC-ICP-MS

12:00 -12:30 Marcus Brittain

South Georgia’s sealing heritage: Archaeology in the Antarctic

12:30 – 13:30 Lunch

13:30 – 14:30 Zoology Museum Visit (David Attenborough Building, Downing Street, CB2 3EJ)

14:30 - Drinks at the Eagle Pub (8 Benet Street, CB2 3QN)
ABSTRACTS

Friday 20th September 2019

Session 1

10:00  Hunting for patterns – Integrating cetacean ZooMS
       Jacqui Mulville and Sally Evans - Cardiff University

The emergence of proteomics as a tool for species identification has created new opportunities for research into zooarchaeological assemblages. In particular, the low cost of high throughput analyses is allowing us to examine substantive assemblages in detail. This paper demonstrates we have used ZooMS (ZooArchaeology by Mass Spectrometry) to characterise examined of fragments of morphologically unidentifiable cetacean material from settlement sites in Scotland.

One of our approaches has been to explore domestic deposition by analysing at least a single sample from a series of floor levels over the duration of a single house occupation. This has generated a large and detailed ZooMS dataset and challenged our previous understanding of which species were utilised. This paper compares the species distributions generated by both traditional and proteomic methodologies and considers the advantages and challenges that emerge with the creation of these new substantive datasets.
10:30 Creation of an osteological reference for cetaceans in archaeology manual
Youri van den Hurk - Institute of Archaeology, University College London

The field of zooarchaeology is concerned with reconstructing human-animal interaction in the past. Cetaceans have been neglected by zooarchaeologists for a long time. This can partly be ascribed to the fact that their remains are often extremely fragmented and there is a lack of high-quality osteological reference collections. These factors render identification to the species level problematic, resulting in a poor understanding of human-cetacean interaction in the past.

Recently however, new methods have shed more light on the history of cetacean exploitation, including aDNA research and Zooarchaeology by Mass Spectrometry (ZooMS). For this study, however a more traditional zooarchaeological method to analyse cetacean material was created: an osteological reference manual. Several medieval cetacean specimens from North-Western Europe were subsequently analysed using both this manual as well as ZooMS to identify the remains to species level. The results showed that a wide variety of species were exploited during the medieval period.

11:00 Marine mammal evidence from settlements of the French shore of The Channel
Tarek Oueslati¹, Camilla Speller², Krista McGrath³, Rémy Blondeau⁴, Patrice Herbin⁵, Gaëtan Jouanin⁶, Tristan Moriceau⁷ and Sandie Poisson⁷

¹CNRS HALMA UMR8164 Université de Lille
²Department of Anthropology, University of British Columbia
³Department of Archaeology, University of York
Rescue excavations in Northern France provide some evidence of the interaction between coastal populations and marine mammals, mainly whales, and in some instances dolphins and seals. The purpose of this paper is to present an inventory of the recent discoveries and the first trials of identification of the fragmentary bones through collagen analysis (ZooMS). Three species of whales have been identified up to now with Gray whale *Eschrichtius robustus*, Right whale *Eubalaena glacialis* and Fin whale *Balaenoptera physalus*. Only one site has provided a concentration of vertebrae some of them perforated suggesting that they had a functional use. Another site dated 9th-10th century has provided a rib with two circular perforations and partially burnt bones baring cut marks. Finally, vertebrae were used as chopping board in another instance. When smaller marine mammals occur on archaeological sites, they appear to be butchered for consumption.

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**Session 2**

**11:50  Early cetacean exploitation: An Orcadian perspective**

Claire F. MacKay - *University of Highlands and Islands (Orkney College), Kirkwall, United Kingdom*
The emergence of proteomics as a tool for species identification has created new opportunities for research into zooarchaeological assemblages. In particular, the low cost of high throughput analyses is allowing us to examine substantive assemblages in detail. This paper demonstrates we have used ZooMS (ZooArchaeology by Mass Spectrometry) to characterise examined fragments of morphologically unidentifiable cetacean material from settlement sites in Scotland. One of our approaches has been to explore domestic deposition by analysing at least a single sample from a series of floor levels over the duration of a single house occupation. This has generated a large and detailed ZooMS dataset and challenged our previous understanding of which species were utilised. This paper compares the species distributions generated by both traditional and proteomic methodologies and considers the advantages and challenges that emerge with the creation of these new substantive datasets.

12:20 The exploitation of cetacean bone by Magdalenian foragers of the Cantabrian region between 20 and 13 cal ka BP
A. Lefebvre¹,²,⁶, J.M. Pétillon², E. Álvarez-Fernández³, M. De la Rasilla Vives⁴, E. Duarte Matías⁴, M. Cueto⁶, J. Tapia⁵, Ana B. Marín-Arroyo⁶

¹ CNRS PACEA UMR 5199, Univ. Bordeaux, Allée Geoffroy Saint-Hilaire, 33615 Pessac cedex, France
² TRACES UMR 5608, Univ. Toulouse Jean Jaurès, Maison de la Recherche, 5 Allée Antonio Machado, 31058 Toulouse cedex, 9, France. jean-marc.petillon@univ-tlse2.fr
³ Dpto. de Prehistoria, Historia Antigua y Arqueología, Univ. of Salamanca, C. Cerrada de Serranos s/n, E-37002 Salamanca, Spain. estebanalf@hotmail.com
⁴ Área de Prehistoria, Departamento de Historia, Facultad de Filosofía y Letras, Universidad de Oviedo. C/ Amparo Pedregal,
A few years ago, the discovery of more than a hundred projectile points and tools made of whale bone by Magdalenian groups dwelling on the northern slopes of the Pyrenees between ca. 17,5-15 cal ka BP has shed new light on the interactions between foragers and the littoral environment at the end of the Upper Palaeolithic. To verify whether whale bone working was only a phenomenon limited to the Pyrenees or was shared more globally by Atlantic communities, we conducted a systematic review of the major bone industry assemblages from the Cantabrian region, including the Asturias, Cantabria, Bizkaia, Guipuzcoa and Navarre autonomous communities. The results of this study, which is funded both by the Fyssen Foundation (CetOs project) and by the French ANR (PaleoCet project), will be presented and discussed through the questions of technical and economic adaptations of foragers to coastal environment all around the Gulf of Biscay at this period.

12:50

Hydrophobic preservation of DNA in ambergris and implications for whale gut microbiomes
Ruairidh Macleod1,2, Mikkel-Holger S. Sinding1,3, Matthew Collins1,4, Morten Tange Olsen1, Steve Rowland5

1 Section for Evolutionary Genomics, The GLOBE Institute, Faculty of Health and Medical Sciences, University of Copenhagen
2 Homerton College, University of Cambridge
Poster introduction: For centuries, ambergris, a waxy precipitate found in the rectum of about 1% of sperm whales, has been valued for a number of purposes, including in perfumes, medieval medications, and as incense in Ancient Egypt (e.g. Brito et al. 2016). The favourite meal of Charles II was noted as ambergris and eggs (Macaulay, 1849). Its prized aromatic characteristics result from its chemical composition, predominantly the terpene ambrein, rendering it hydrophobic and unreactive to acid. Within the gut microbiome of whales, Firmicutes and Bacteroidetes or other microbes, are suggested as synthesising ambrein (Rowland et al. 2018, 2019), conveniently also facilitating the conditions for preservation of gut microbiome DNA, as well as other biomolecules. Here, we undertake DNA extraction and shotgun sequencing for preserved metagenomic sequences within ambergris, and present findings on mitogenome alignments for species characterisation and gut microbiome diversity. These initial findings and perspectives on further research will provide significant implications upon understanding past whale ecology, population structure and evolution.


**Session 3**

14:00 **Marine mammals at the Natural History Museum (NHM), London: 250 years of collecting**

Richard Sabin, Division of Vertebrates, Department of Life Sciences, The Natural History Museum

The Life Sciences Marine Mammal research collection at the NHM is one of the most important scientific resources of its kind. It is a global collection of more than 6500 cetaceans and pinnipeds, represented primarily as skeletal specimens, as well as fluid-preserved or study skins. Species representation is high, and time-series extend back to the late 18th/early 19th century. Advances in analytical technologies over the past two decades have seen the collection used increasingly for investigation of DNA and stable isotopes, and more recently for chemical and lipid content. As part of the NHM’s ongoing collections digitisation programme, a recent pilot project saw 3D laser surface scanning of the skulls and skeletons of several large cetacean species to generate data for macroevolutionary and other taxonomic studies. Richard Sabin, Principal Curator of Mammals at the NHM has worked to develop the marine mammal collection over the past 20 years, and will give an overview of its significance to modern science.
The UK Antarctic Heritage Trust and conducting whale satellite imagery analysis with the British Antarctic Survey
Penny Clarke¹,²

¹ UK Antarctic Heritage Trust, Cambridge
² British Antarctic Survey, Cambridge

The UK Antarctic Heritage Trust, established in 1993, aims to promote a greater public engagement with Antarctica. We achieve this particularly through the management of six Historic Sites and Monuments on the Antarctic Peninsula. Port Lockroy, our flagship site, was, for a time, a significant whaling harbour on the Peninsula between 1911-1931, contributing to decimated whale populations across the Southern Ocean. Today Port Lockroy is one of Antarctica's most popular visitor sites, with more than 17,000 visitors during the Antarctic summer months. Aware of the increasing human activity in the region, I sought opportunities to understand and monitor Antarctic whale populations; to educate others of the concerns for recovering whale populations. Currently as part of the British Antarctic Survey and WWF 'Whales from Space' project, I am helping to establish satellite imagery as a tool to monitor Antarctic whale populations and develop a long-term monitoring programme for remote whale populations.

Understanding genetic diversity and foraging differentiation of baleen whales in the South Atlantic prior to 20th Century whaling
Danielle Buss¹,²,³

¹ Department of Archaeology, University of Cambridge, Cambridge
² British Antarctic Survey, Cambridge
2.1 million baleen whales were commercially harvested in the Southern Hemisphere during the 20th Century whaling period (1904-1986). Despite extensive whaling records providing good information on species distributions and foraging behaviours during exploitation, the genetic diversity, structure and trophic partitioning of baleen whale species prior to this time is unknown.

At the start of 20th Century whaling (<1920) whale bones were discarded on the beaches surrounding Antarctic and sub-Antarctic whaling stations. These bones provide an invaluable resource to understand baleen whale populations in the past. My Ph.D. research utilises the British Antarctic Survey's extensive whalebone collection (>500) to understand 'pre-exploitation' population diversity, connectivity and foraging differentiation of three baleen whale species in the South Atlantic (Balaenoptera borealis, Balaenoptera physalus and Megaptera novaeangliae). Foraging differentiation is inferred using stable isotopes, whilst population diversity and connectivity is measured using DNA analysis.

Preliminary results based on an extremely small sample size (<20 individuals) suggest 20th Century whaling has not altered the trophic ecology or genetic diversity of one species, Balaenoptera borealis, in the South Atlantic. Results for the other species are not yet available, therefore, this presentation will mainly focus on the background, aims and methodological approaches of the project including any hurdles encountered so far, and then briefly touch upon any preliminary results.
A 16th Century Spanish account describes whales “as large as a hill” being captured by Florida Indians. According to this account, a single Indian would jump onto the back of a whale, then hammer a “sharp and strong wood pole (...) through a window in the nose of the Whale (...) in such way that he blocks it all, and takes away its breath”. Considered too fantastic to warrant serious consideration, this account is either omitted from or rubbished in authoritative works on the history of North American whaling. This presentation will bring together additional historical records and analyse them in the context of evidence from ecology, animal physiology, archaeology and archaeozoology. We argue that not only Indigenous peoples of Florida hunted whales prior to European contact, they probably did so using the apparently fantastic methods described. This forgotten whaling technique likely targeted the calves of gray whales or of North Atlantic right whales.
The sea otter (*Enhydra lutris*) was nearly driven to extinction on the Pacific Coast due to the 19th century maritime fur trade. Despite successful reintroduction efforts in North America, the Oregon sea otter population remains locally extirpated. Prior studies have used precontact and modern sea otter phenotypic and genetic analyses to compare ancient Oregon and modern California/Alaska sea otters, suggesting variation along the Northwest Coast. We expand upon previous genetic studies by generating complete ancient Oregon sea otter mitogenomes from two archaeological sites in northern Oregon. We present new data on ancient mitogenome diversity compared to modern California otters. Preliminary analysis also suggests these ancient individuals are more closely related to modern/historic northern sea otters than modern California otters. By applying genetic analyses to zooarchaeological remains we contribute to the historical ecology of sea otters in Oregon and demonstrate the relevance of archaeological remains to conservation biology decisions as part of interdisciplinary projects.
The impacts of early ecological globalisation may have had profound economic and environmental consequences for human settlements and animal populations. Here, we review the extent of such historical impacts by investigating the medieval trade of walrus (*Odobenus rosmarus rosmarus*) ivory. We use an interdisciplinary approach including chaîne opératoire, ancient DNA (aDNA), stable isotope and zooarchaeological analysis of walrus rostra (skull sections) to identify their biological source and subsequent trade through Indigenous and urban networks. This approach complements and improves the spatial resolution of earlier aDNA observations, and we conclude that almost all medieval European finds of walrus rostra likely derived from Greenland. We further find that shifting urban nodes redistributed the traded ivory and that the latest medieval rostra finds were from smaller, often female, walruses of a distinctive DNA clade, which is especially prevalent in northern Greenland. Our results suggest that more and smaller animals were targeted at increasingly untenable distances, which reflects a classic pattern of resource depletion. We consider how the trade of walrus and elephant ivory intersected, and evaluate whether emergent globalisation and the “resource curse” contributed to the abandonment of Norse Greenland.
The story of the Baltic Sea harp seal: Reconstructing the history of an extinct population
Aikaterini Glykou, Gunilla Eriksson and Kerstin Lidén,

*Archaeological Research Laboratory, Stockholm University, SE-10691 Stockholm*

The harp seal (*Pagophilus groenlandicus*), today a subarctic species with breeding populations in the White Sea, Jan Mayen and around Newfoundland, was a common pinniped species in archaeological sites from the Baltic Sea region during the mid- and late Holocene. Previous studies based on osteometrical analysis of bones from young harp seals provided evidence that the species had local breeding populations in the Baltic Sea during the late Mesolithic and Middle Neolithic. Still, it is puzzling how a cold adapted species could breed in the Baltic Sea during the Holocene Thermal Maximum and it remains uncertain when harp seals started to reproduce in the Baltic Sea, for how long local breeding populations existed in the Baltic Sea and when they became extinct. We apply a multidisciplinary approach by combining osteometrical data, $\delta^{13}$C data, $^{87}$Sr/$^{86}$Sr data, radiocarbon dating and palaeoenvironmental data to discuss the presence of harp seals in the Baltic Sea during the Holocene and reconstruct their population dynamics.

Seal economy of the Åland Islands and county of Raseborg ca. 1200-1600 CE
Hanna Kivikero

*University of Helsinki, Department of Culture (archaeology)*
Seals were of importance to the economy of Åland Islands from the Stone Age to the Late Iron Age. The historical periods are so far known through tax records and ethnographical descriptions. Less is known of the use of seals in southwestern parts of Finland from historical period. Based on analysis of zooarchaeological assemblages and castle account books from Kastelholm (Åland Islands) and Raseborg (southwestern Finland) there seems to be an interest to seal products in both castles but differences occur due to the main subsistence of the area. When castle sites are compared with ecclesial and hamlet sites, differences in the anatomical distribution and the number of seal bones are likely to occur due to the different use of the sites. Large part of the seal products were not used in the castles but transported to the castle of Stockholm, centre of Medieval Sweden.

10:00  **Exploitation of Baltic seals analysed through ancient DNA**

Maiken Hemme Bro-Jørgensen, Hans Ahlgren, Aikaterini Glykou, Morten Tange Olsen and Kerstin Lidén

This project investigates ancient genomes of grey seals and harp seals in the Baltic Sea in order to study genetic changes, as well as life history and demographic processes associated with environmental changes and hunting of the seals in the past. Grey seals colonized the Baltic Sea more than
9000 years ago. The now extinct Baltic breeding population of harp seals was established during the Late Atlantic to Early Sub Boreal Period. According to archaeological and archaeozoological analysis both grey seals and harp seals were heavily hunted during different stages of the Holocene in the Baltic Sea region, first by hunter-gatherer societies and later during the Neolithic Period by Pitted Ware communities. We aim to investigate any genetic changes in the seal populations through periods of climatic changes and human exploitation, as well as combining age and sex determination to estimate traces of selective hunting.

Session 2

11:00  **Hiding in plain sight: The biomolecular identification of pinniped use in medieval manuscripts**
Matthew Teasdale¹, Élodie Lévêque²,³, Sarah Fiddyment¹, Maiken Hemme Bro-Jørgensen⁴,⁵, Morten Tange Olsen⁶ and Matthew Collins⁶,⁷

¹ BioArCh, Department of Archaeology, University of York, York, United Kingdom.
² Department of Preservation, Trinity College Library, Trinity College Dublin, Dublin, Ireland.
³ ArScAn, Université Paris X Nanterre-La Défense, Université Paris Nanterre, 92001 Nanterre, France.
⁴ Archaeological Research Laboratory, Stockholm University, Stockholm, Sweden.
⁵ Section for Evolutionary Genomics, University of Copenhagen, Copenhagen, Denmark.
⁶ Evolutionary Genomics, Department of Biology, University of Copenhagen, Copenhagen,
The medieval manuscript collection of Clairvaux Abbey and Clairmarais contains over 1300 documents, amazingly 28 bindings remain in their original state with their chemises (outer cover) almost intact. The chemises are described in library catalogues as boar/deer skin, however, visual analysis of the follicles doesn’t match either animal.

To try to identify the animal origin of the chemises we applied non-invasive proteomic and genomic analyses to seven documents from the Clairvaux/Clairmarais collection. Proteomic analysis identified the skins as belonging to pinnipeds with DNA sequences further resolving the species of origin for six documents, revealing five chemises as being produced from harbour seal (*Phoca vitulina*) skin and one from harp seal (*Pagophilus groenlandica*) skin. Comparing with DNA sequence data from contemporary populations, four of the harbour seal skins could be genetically assigned to the Danish/Swedish harbour seal population, suggesting trade of seal products. This analysis highlights that medieval documents may contain a biobank of genetic information for species outside of the traditional parchment production animals.

**11:30 Intra- and inter-tooth variation in strontium isotope ratios from prehistoric seals by laser ablation (LA)-MC-ICP-MS**

A. Glykou¹, G. Eriksson¹, J. Storå², M. Schmitt³, E. Kooijman³ and K. Lidén¹
Strontium isotope ratios ($^{87}\text{Sr}/^{86}\text{Sr}$) in marine environments are considered to be homogeneous averaging 0.7092. However, in the Baltic Sea there is major influx of freshwater, since more than 50 rivers discharging into the Baltic drain sedimentary rock-bearing areas of the Baltic Shield with different geological origin and thus different strontium isotope ratios. This results in mixing of sea water and continental drainage, leading to regional variations of strontium isotopic ratios. The aim of this pilot study was to explore if these regional variations of Sr can be detected in marine mammals from archaeological sites in the Baltic Sea. This was investigated by performing a sequential measurement of $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in tooth enamel from three seal species by using laser ablation MC-ICP-MS. An inter-tooth $^{87}\text{Sr}/^{86}\text{Sr}$ variation can be detected in marine mammals that lived in the Baltic Sea, suggesting that different Sr ratios can be detected in different regions of the Baltic Sea. Furthermore, an intra-tooth variation suggests possible different geographic origin or seasonal movement of seals within different regions in the Baltic Sea through their life time. The data show clearly that we deal with a non-homogenous strontium isotope ratio in the Baltic Sea Basin. Archaeological implications are discussed.
South Georgia’s sealing heritage: Archaeology in the Antarctic
Marcus Brittain

Cambridge Archaeological Unit, University of Cambridge

During the late eighteenth and nineteenth centuries, the annual harvest of the seal population at the sub-Antarctic island of South Georgia to meet the global demand of the fur and blubber oil markets was of such proportion that by the early 20th century their near extinction demanded cessation of hunting activities. With beach-side breeding grounds empty of seal life, the growth of thick tussock grass gradually preserved traces of the occupation and processing sites of the sealing industry. Today, the success of forty years’ conservation strategies has seen an upsurge of seal life at South Georgia, an outcome of which is the erosion of the tussock coverage and exposure and damage of historic sites. This paper outlines the recent work of the South Georgia Archaeological Project to investigate and document these sites, and the challenges faced in decisions concerning sealing heritage within an ecologically sensitive region.

Thank you and have a lovely weekend