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Mapping the Past and Future of Gray Whales and People on the Pacific Coast of North America

Jason Colby (keynote speaker)

University of Victoria

This presentation will explore the shared history and intertwined future of gray whales and people. Hunted nearly to extinction in the nineteenth century, eastern Pacific gray whales made a remarkable recovery in the mid-twentieth century, despite escalating human impacts on their coastal environment. By the 1970s, the species had become an icon of ecological recovery and international tourism, spurring excitement around the promise of "friendly whale" encounters in the lagoons of Baja California. In the process, the changing relationship between gray whales and people transformed cultural and spatial relations, bringing the species into the imagined community of the Pacific Coast. Yet this success story remained fragile. By the late 2010s, the population again began to decline, raising concerns about the impact of climate change as well as revival of Indigenous whaling. This presentation will draw upon archival and oral history sources, but its centerpiece will be an animated digital map, which juxtaposes human and gray whale history on the Pacific Coast of North American since 1840. By integrating scientific and historical data, it will highlight the potential of environmental and digital humanities to enhance our understanding of ecological recovery in the past and sustainable management in the future.

Session I – Cross-disciplinary studies of marine animals

Monitoring the foraging preferences of North Atlantic right whale, *Eubalaena glacialis* and fin whale, *Balaenoptera physalus* over time using archaeological, and museum specimens

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Unsustainable hunting between the 16th and 20th centuries led to large population declines for many whale species. Whales provide an array of ecosystem services including nutrient cycling and carbon sequestration. Therefore, the removal and recovery of whales is likely to impact ecosystem functioning. Nonetheless, we lack a thorough understanding of the foraging preferences of baleen whales which makes it difficult to assess the ecological consequences of whale population recoveries, or extinctions. Here, using stable isotope analysis of historical specimens we inferred past foraging preferences of two species of whale, the North Atlantic right whale (*Eubalaena glacialis*) and the fin whale (*Balaenoptera physalus*) in the North Atlantic. *E.glacialis* was one of the earliest exploited species and is now critically endangered with a population size of less than 300 individuals. *B.physalus* has globally been the most heavily exploited in terms of absolute abundance with over 800,000 individuals hunted worldwide. The population size is currently increasing, with approximately 80,000 individuals in the North Atlantic. Here, we compare our historical isotope data to modern specimens to identify evidence of variation in foraging preferences over time, which are currently on very different population trajectories (decline vs. recovery) since the 1986 moratorium on commercial whaling.

The Demise of the Atlantic Grey Whale; New biomolecular archaeological findings on an extirpated whale population

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Understanding the extirpation of the grey whale (*Eschrichtius robustus*) from the North Atlantic is more vital than ever, as four individuals from the North Pacific have re-entered the North Atlantic in recent years, possibly signalling a recolonisation of the species in the Atlantic Ocean. Although, the grey whale now only resides in the North Pacific, historical, palaeontological, and archaeological evidence suggest that this species used to be present in the North Atlantic but was extirpated from this ocean basin at some point during the late Holocene. Here, using radiocarbon dating of archaeological and palaeontological grey whale specimens from the eastern North Atlantic, we reconstruct when the grey whale disappeared from the eastern North Atlantic. Results from radiocarbon dating suggest that extirpation of the grey whale from the North Atlantic directly correlates with medieval whaling activities, indicating that early whaling was even more destructive than previously assumed. Moreover, using stable isotope analysis we infer the past foraging behaviour of the grey whale and use this to infer the ecological niche that they would have occupied in the North Atlantic in the past.

Birds of a Feather: Cultural and ecological relationships between the Unangax̂ and seabirds on Sanak Island, AK

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Seabirds were, and continue to be, an important resource for the Unangax̂ living in the Aleutian Archipelago, AK. Oral history and ethnographic accounts document the extensive roles that birds play as sentient beings in Unangax̂ ontologies. Notably, seabirds were used for bird-skin parkas, bone tools, and ornamentation. We examine how temporal changes in environmental conditions may be impacting seabird foraging locations and trophic position, and subsequently, human hunting strategies and landscape use. Here, we use zooarchaeological data and stable isotope analysis of δ^{13}C and δ^{15}N in bone collagen from seabirds recovered from ancestral Unangax̂ middens. Cormorants and murres were the most numerous seabirds recovered from archaeological sites on Sanak and are the only seabird genera to show significant changes in δ13C and δ15N through time (cormorants: δ^{13}C $p<0.07$, δ^{15}N $p<0.01$, murres: δ^{15}N $p<0.01$). While changing environments did alter seabird feeding ecology, they did not appear to influence human hunting strategies and/or the availability of seabirds on the landscape. This retrospective study can inform modern seabird management decisions and serves as a springboard for future long-term ecosystem studies using compound-specific stable isotope analysis (CSIA-AA). Lastly, it provides an ecological backdrop to further investigate the relationship between seabirds and the Unangax̂.

Session II – Insights from Molecular and Isotopic Studies I

Quaternary marine palaeoecology, molecular biology and geochemistry; challenging the shifting baseline syndrome

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The palaeoenvironmental interpretation of Quaternary marine sequences has hitherto been dominated by physical environmental proxies for palaeoclimatic and sea level reconstructions. Yet these sequences, and other marine biotic archives, such as coral, coralline algae, molluscan shell, fish and marine mammal bone, also contain a wealth of information on past biodiversity and ecosystem functioning. Only very rarely is the totality of the preserved fossil assemblage analysed from marine sedimentary sequences. When well-dated these data can provide insights into the richness of past ecosystems, the role of keystone species, and provide ecological baselines that challenge the "shifting baseline" syndrome. Even these more comprehensive analyses, however, can only capture a fraction of former marine ecosystems because of taphonomic loss. Novel approaches to marine ecosystem reconstruction, including sedimentary environmental DNA (eDNA) and compound specific stable isotope geochemistry, are now able to provide insights into the total biodiversity of former marine ecosystems, and ecosystem functioning, respectively. Combined with classical palaeoecological approaches, these techniques together provide powerful integrative tools for the reconstruction of marine ecological baselines. Such reconstructions provide evidence-based targets for marine conservation biology and an informed basis for the rewilding of the oceans. Case studies from the ongoing SEACHANGE Project will be presented.

Measuring Antarctic human impacts using sedimentary ancient DNA

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The Southern Ocean is perceived as a pristine wilderness. However, some southern seas have been subject to intense sealing and whaling over several centuries. Moreover, the region is on the frontline of human-induced climate change and is among the fastest warming marine ecosystems on the planet. One key problem in understanding remote ecosystems is limited data against which to measure ecosystem changes. Recently, the use of ancient DNA preserved in sediment records (ancient eDNA) has emerged as a useful tool to understand past ecosystems for which no long-term records exist. Here, we present reconstructed biological timeseries data from three short (<40cm) sediment cores collected from the Western Antarctic Peninsula. We used eDNA metabarcoding to amplify three gene fragments targeting eukaryotic, vertebrate and mammalian species from chronologically constrained sediment layers (^{210}Pb isotopes). We show changes in the detection of marine mammals subject to intense hunting pressure along our timeseries, which we attribute to changing distributions in response to human pressure. We additionally present changing spatial and temporal distributions of keystone zooplankton, likely in response to human-induced climate change. Our data provides novel insights into the state of past ecosystems and offers a glimpse of a pristine Southern Ocean.

Isotopic and phylogenetic examinations of archaeofaunal remains from Hokkaido, Northern Japan, with special reference to northern fur seal and Pacific cod remains

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Isotopic and phylogenetic information on archaeofaunal remains plays an important role in reconstructing the long-term change in marine ecology. Faunal remains from archaeological sites have been actively used for this purpose in the eastern North Pacific. However, in the western North Pacific, there are few instances of these studies because materials from archaeological sites are basically used to reveal human diet and technology for hunting and fishing in the region. This study examines archaeofaunal remains from the viewpoint of paleoecology. We present the result of carbon, nitrogen, and oxygen stable isotope analysis and DNA analysis of northern fur seal and Pacific cod remains from Hokkaido, northern Japan. Also, we discuss the effectiveness and perspective of paleoecological studies using archaeofaunal remains in the western North Pacific although it is still difficult to derive a distinct conclusion on the temporal change in marine ecosystem based on this preliminary research.

Multidisciplinary perspectives on the marine historical ecology of fishes in the eastern Mediterranean

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Millennia of anthropogenic actions have had profound impacts on terrestrial and aquatic ecosystems. The long history of marine resource exploitation and ongoing consequences of opening of the Suez Canal in 1869 poses the Mediterranean region as an excellent case study in marine historical ecology of applying multidisciplinary approaches to zooarchaeological assemblages. An emphasis will be placed on groupers (Epinephelidae) due to their high ubiquity in coastal Mediterranean archaeological contexts and due to their ecological and economic importance today. Archaeological material studied comes from three coastal Levantine archaeological sites; Kinet Höyük in Turkey and Tell Fadous-Kfarabida and Tell el-Burak in Lebanon. Osteometrics were used to reconstruct catch sizes in the past, assess for fluctuations in the size structure of past grouper populations, and revise current conservation targets. Stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$) of archaeological fish bones (13 families) was undertaken to reconstruct the foraging ecology of ancient marine ichthyofauna in the eastern Mediterranean to assess the ongoing impacts of bioinvasions. Lastly, proteomic analysis of four grouper species in the Mediterranean was carried out for reconstruction of collagen sequences, revision of grouper phylogeny, and historical insight regarding past species abundance. This piece of work establishes ecological baselines for Mediterranean fisheries and showcases the importance of long term perspectives and multidisciplinary approaches in historical ecology.

Exploring historical interactions between Humans and Fish through Ancient DNA Studies on Chum Salmon (*Oncorhynchus keta*) and Pacific Cod (*Gadus macrocephalus*) Remains from Hokkaido, Japan

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Anadromous and marine fish, such as Chum Salmon (Oncorhynchus keta) and Pacific Cod (Gadus macrocephalus), have been integral to the foodways of the Indigenous Ainu people of Hokkaido, northern Japan. After AD 1868, Hokkaido experienced significant ecological disruptions related to colonization, industrial fishing, and climatic changes, that severely effected many fish species, including Chum Salmon and Pacific Cod. This study seeks to investigate the deep history of human interactions with Pacific Cod and Chum Salmon by applying ancient DNA analysis to the total of 234 archaeological fish remains from ancestral Ainu sites throughout Hokkaido that span a period of over ten millennia. Though the examination of both mitochondrial and nuclear DNA SNPs, we sought to document human impacts on these two taxa by tracking the historical fluctuations in their genetic diversity. Our findings showcase the profound impact that human activities have had on the marine biodiversity of Hokkaido and reveal the long-term Indigenous interactions with Chum Salmon and Pacific Cod.

Poster Briefs

Iberian whaling under an artistic lens (10th - 13th centuries). Analysis of Artistic objects made from whale raw materials

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The whale was one of the most important animals hunted off the Iberian coast during the Middle Ages. Various products essential for daily life could be extracted from this animal, such as blubber and meat. Additionally, the animal's bones and ivory also left their mark on medieval Iberian society. This raw material is to be identify in architecture, material, and visual culture. Namely, ivory and bone were used in covers of manuscript and caskets, or even used to produce personal adornments. Taking as a starting point my PhD project, entitled "Marine Ivory in Medieval Europe from the 10th to the 13th centuries", focuses on the hunting, circulation, and use of raw materials from whales, walrus, and narwhal, our aim is to understand the impact whales had on medieval Iberian society and how these societies were influenced by whaling culture, through art and its contextualization.

Unpath'd Waters

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Unpath'd Waters is part of the AHRC's 'Towards a National Collection' research and development programme, which aims to bring together and make accessible the UK's maritime heritage data collections. The University of Bradford leads the work package titled 'The Lands Beneath the Sea', which has two main elements. The first involves bringing together the various geophysical and geological data sources relating to Doggerland, the previously inhabited landscape which now lies beneath the southern North Sea. This task includes continually collating data on landforms and depositional environments from the late Palaeolithic to early Mesolithic period. These data are sourced from commercial, governmental and academic sources, including outputs from existing and previous research at the Submerged Landscapes Research Centre. From this we will create the most complete map of this submerged landscape to date, and a simulation which allows users to gain a sense of how this landscape may have been experienced by its inhabitants. The data of Doggerland do not just consist of the prospected terrain features but also the environmental processes and human hose evidence comes from elsewhere. Our simulation combines all these elements into an accessible software package, allowing users with a wide range of abilities to investigate lands which have been uninhabited for millennia.

The Submerged landscapes Research Centre

Vince Gaffney[1]

1. Submerged Landscapes Research Centre, University of Bradford

The Submerged Landscapes Research Centre supports studies into marine palaeolandscapes and wetland landscapes and is based at the University of Bradford. Our vision in founding the centre has been to provide a unique research group, aimed at the study of global prehistoric, marine and wetland palaeolandscapes and underpinned through the development of novel research methodologies and data analytics. Current and past research projects include – Europe's Lost Frontiers - an ERC Advanced Grant studying the Early Holocene landscapes of the southern North Sea Taken at the Flood – an AHRC funded programme to provide new methods for palaeolandscape projection and to interface with the Offshore energy sector in learning how to manage marine palaeolandscapes Life on the Edge - a UKRO FLF project " which seeks to undertake innovative archaeological research into the Late Palaeolithic (20,000 to 10,000 years ago) at a global level. The Lands Beneath the Sea - (Unpath'd Waters) part of the AHRC's 'Towards a National Collection' research and development programme, which aims to bring together and make accessible the UK's maritime heritage data collections. Wet Futures - a JPICH project studying wetland threats and research. Subnordica – an ERC Synergy project undertaking palaeolandscape research across the North Sea and Baltic Sea

Cetacean (Re)Sources: Uncovering historical insights into British Empire and whaling using the Cetacea collection at the Natural History Museum, London

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1. Natural History Museum, London

The Natural History Museum, London, (NHM) holds a globally significant Cetacea collection, recognised for its temporal and geographical range. Key contributing factors to its range are British imperial exploration, territorial and administrative expansion, and whaling in the Southern Hemisphere from the late nineteenth to mid-twentieth centuries. By uncovering specimens' colonial acquisition histories and (re)contextualising them within legacies of empire and whaling, specimens are evidence for the moment of collection and the world explorers, scientists and whalers were active in. The historical picture around extraction sheds light on the ecosystems that they came from, observed whale populations, changes and declines, and the attitudes and activities driving these. Cetacean specimens obtained from British colonies in the late 1800s represent more traditional collecting practices. However, with the consolidation of industrial whaling in the South Atlantic and associated declines of whales in the early 1900s, there is a shift in the collection. Responding to senior Museum figures' concerns about commercially targeted whales, concerted efforts went into obtaining specimens and data from whaling operations between the 1920s and 1960s. I highlight how changing socio-economic and environmental conditions shaped NHM's collection, manifesting in collecting biases, and how specimens continue generating insights into the consequences of Empire.

Using Historical Analysis to Inform the Ecological Applications of Nautical Charts

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As coastal ecosystems collapse, the historical dynamics of kelp (Laminaria spp.) forests have become a valuable topic of study, as they indicate long-term impacts of climate change. Nautical charts created by 19th-century European cartographers often include historical representations of kelp forest abundance, and are useful for reconstructing historical kelp ecosystems on the west coast of North America. However, ecologists are currently using nautical charts as sources of raw data, with scarce consideration for the bias introduced by larger historical contexts. The nautical charts representing 19th-century North America were subject to European interpretations of the land, and were created intentionally to claim territory, erase Indigenous presence, and identify resources for extraction. It is imperative to understand how and why a source was created before using it for scientific study. My research will investigate the historical context of 19th-century nautical charts, identifying sources of bias. After selecting key individuals and expeditions associated with charts of interest, I will research the backgrounds, experiences, and motives of individual cartographers, as well as the methodology of 19th-century cartography. Using nautical charts as a case study, I will demonstrate the need for historical research—not just historical sources—in ecology and environmental conservation.

Historical data provides insights into the distribution and form of clam natural beds in Galicia (NW of Spain)

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From a social and economic point of view, clams are an important fishery and farmed species for the bivalve production sector at regional, national and European level. The first reference to the exploitation of shellfish resources that is reported were some shells deposits in pre-Roman human settlements (400 BC) in Galicia, called “concheiros”. Natural clam beds have experienced some mortality events in the recent years. This, together with the intensive extraction activities by shellfish gathers, has led to a decline in clam populations. Furthermore, the reproduction and the first life stages of bivalves could be affected by the highest intensity and frequency of extreme rainfall and heat waves episodes associated with climate change. The main objective of this study is to identify and quantify the populations decline of clam beds in Galicia, Spain (NW Atlantic) using publicly data from the Regional Government and historical written sources. This study could help to understand the presence of the natural clam beds over time, improve the knowledge of their dynamics and contribute to the restoration of these ecosystems.

The depths of settler-colonialism: the case of the Libyan Sea

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1. ERC-CoG DEEPMED

Following the ERC-CoG DEEPMED, this paper sets out to investigate how an analysis of the colonisation of the seafloor can help us change our understanding of the history of imperialism. To do so, it takes as case study the Italian colonisation of Libya that took place in 1911. Specifically, the paper proposes to analyse and assess the construction of submarine telegraph cables between Italy

and Libya that was initiated in 1911. It proposes to answer the following questions: how did this piece of infrastructure influence the colony and the native society in it? In what way does a piece of colonial infrastructure that is built underwater change colonial policy and agency? Can this case study contribute to argue that settler colonialism can happen on water as well as on - as it is traditionally believed - on land? The paper sets to add to the literature on history of marine infrastructure and environment by arguing that the element of deep water both hinders the potential for resistance (sabotage of infrastructure becomes practically harder if its underwater), while at the same time it complicates colonisation, as the traditional tools of such enterprise (i.e mapping) become less efficient underwater.

Shaping images of/by the sea - ancient Mesopotamian and Mayan symbolic maritime representations

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1. CHAM-Centre for Humanities, NOVA FCSH, Lisbon

Recent years saw the development of interdisciplinary work intertwined in a broader movement of Environmental or Blue Humanities. As such not only new data emerged but also long-available sources were revisited, allowing to understand how past human societies had a closer relationship with the maritime environments than previous though. Following the work that we have been conducting together, and having in mind my ongoing PhD project, we propose to explore the relationship ancient Mesopotamian and Mayan societies had with the sea through the analysis of some of their religious symbols. We will pay particular attention to iconographic expressions, namely the ones depicted on cylinder seals and on ritual vases, respectively, by means of a comparative perspective. Ultimately, this presentation aims at highlighting the importance of objects embedded in and produced for cultural-religious spheres, to better understand the interrelation between humans and the maritime milieu.

Coastal TALES: Telling Adaptations; Living Environmental Stories for Coastal Resilience – A Belmont Forum New Project in the Climate and Cultural Heritage CRA

Ben Fitzhugh[1], Louise Steel (University of Wales Trinity Saint David), Steven Beschloss (Arizona State U), Poul Holm (Trinity College Dublin), Luci Attala (University of Wales Trinity Saint David), Ben Fitzhugh (University of Washington; corresponding author for OPI X), Carwyn Graves (University of Wales Trinity Saint David), Steven Hartman (University of Wales Trinity Saint David), Hollis Miller (SUNY Cortland), Cordula Scherer (Trinity College Dublin), Gareth Thomas (University of Wales Trinity Saint David), Simon Wright (University of Wales Trinity Saint David), Tracey Gilbert-Falconer (University of Wales Trinity Saint David), and Tamara Swenson (Old Harbor, Ak. Community Partner).

Coastal TALES asks: How can stories of past practices help people (re)discover more sustainable ways of living in their rapidly changing coastal environments? Our goal is to show how heritage stories can generate tangible local action that diverse communities can draw on to adapt to a changing climate. We use a transdisciplinary approach, building on the knowledge and agency of local communities in dialogue with academic expertise across the spectrum of humanities and sciences. Facing a world undergoing significant social and ecological transformation, many people ask, "what can I do?". Individual actions often feel insufficient, with little perceptible effect. Coastal

TALES attends to this growing social need by examining how stories can generate tangible action and offer creative inspiration to local communities and regional environmental stakeholders seeking to adapt sustainably. Coastal TALES collaborates with societal partners to understand how heritage stories can drive action in education, policy and nature-based innovation. We are focusing on three coastal areas (Kodiak Island, Alaska, Dublin Bay in Ireland and southwest Wales) which bring together examples of environmental change affecting distinct communities with a shared sense of urgency. The Kodiak study highlights commercialised fishing in an Indigenous context, encouraging youth to draw on ancestral knowledge as a means to forge environmentally sustainable communities and lifeways. In Ireland oral histories and historical maps help identify practices of managing rising waters with hard and soft coastal defence structures. In Wales revival of local coastal heritage foods is foregrounded, with an emphasis on learning how heritage stories can drive sustainable adaptation. Coastal TALES demonstrates the value of reviving heritage stories in three distinct social contexts, each of which uniquely illustrates how listening to voices from the past and empowering voices of the present can create a legacy for future generations and offer a source of resilience in the face of climate stress.

Scottish Port Books: A Quantitative Analysis Using Machine Learning

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This study is submitted as a part of the Life in the Currents project. The Life in the Currents project is an interdisciplinary project that involves investigating how natural environmental and climatic variability have affected human marine exploitation in the past and present. Through Scottish port books this study seeks to further quantify marine exploitation during the Early Modern period. There has been notable work done on the Scottish marine exports up until 1599, some done until 1649, but very little for the second half of the century leading up to the Union of 1707. Through quantitative analysis, this study aims to make the information contained in the Scottish port books covering the second half of the seventeenth century more accessible. As a primary aspect of this study, a model trained manually through Transkribus will enable digital analysis of the handwritten seventeenth century port books. The goal for this model is to extract and quantify previously unidentified marine resources from the customs records and port books, in order to further inform the study of marine resource exploitation in the Northeast Atlantic during the Early Modern period.

Session III – Insights from Molecular and Isotopic Studies II - Molecular Cod

The Aleutian Mercury Dynamics Project: Researching the history of mercury ecology with archaeological and modern faunal specimens in the Aleutian Islands of Alaska.

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2. University of Alaska Fairbanks, Water and Environmental Research Center.

Our 5-year interdisciplinary research project "Mercury dynamics from the Holocene to the Anthropocene" utilizes faunal remains from ancestral Unangam (Aleut) archaeological middens and modern specimens to research the dynamics of mercury accumulation and Subarctic food webs for the past 5000 years. This first presentation in a series of three frames the research approach and provides cultural and regional contexts. The global processes that concentrate natural and anthropologic mercury in Polar Regions make Coastal and Arctic communities especially vulnerable to the effects of mercury contamination. Pacific cod, Northern fur seals, and Steller sea lions are marine species important to both modern and ancient Alaskan coastal communities, crucial for subsistence, cultural, and commercial purposes. Our study utilizes samples from these three marine sentinel species to research the history of mercury contamination over the last 5000 years along the 1800km Aleutian Island archipelago in the North Pacific Ocean. We use stable isotopes of carbon and nitrogen, concentrations of total mercury, archaeological faunal analyses, climate reconstructions, and cultural knowledge from archaeological and ethnographic literature to interpret changes in mercury concentrations through time and across the archipelago. Research funded by NSF Polar Programs Awards 1935816 & 1935823.

The Aleutian Mercury Dynamics Project: Pacific cod ecology across time and space using bulk carbon and nitrogen isotope analyses

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Pacific cod are important to fisheries and subsistence in both past and present economies. In this presentation we focus on the feeding ecology and mercury dynamics of Pacific cod through carbon and nitrogen bulk isotope analyses ($\delta^{13}C$ and $\delta^{15}N$) as well as total mercury concentration ([THg]) from the eastern and central Aleutian Islands over the past 5000 years. Differences among island and time periods exist, with enriched values of both $\delta^{13}C$ and $\delta^{15}N$ in the east and in more recent time periods. $\delta^{13}C$ values appear to increase through time in both areas. Fish from older ancestral middens are larger; however our data do not indicate a corresponding increase in trophic level at this time. [THg] in cod premaxillas also fluctuates over time, perhaps coinciding with periods of volcanic activity, which potentially led to climate anomalies and increased mercury in the environment. Contrary to initial hypotheses, [THg] does not appear to bioaccumulate in Pacific cod bone. These multi-proxy data can help delineate a pre-Industrial Revolution and commercial fisheries "shifting baseline" for multiple aspects of Pacific cod ecosystems.

The Aleutian Mercury Dynamics Project: refining our understanding of 5000 years of Pacific cod ecology in the Aleutian Islands through compound specific isotope analysis of amino acids

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Carbon and nitrogen bulk isotope analysis of 1440 Pacific cod premaxillas, spanning 5000 years in the Central and Eastern Aleutian Islands has yielded interesting results and raised intriguing questions. Fluctuations in carbon and nitrogen bulk values, but also in fork length of cod are observed through time and space, but are not necessarily linked to climate events. Are these fluctuations caused by changes at the base of the food web? Or do these reflect oceanography and spatial and temporal differences in productivity? What is the role and effect of warmer and colder periods on the base of the food web and how did Pacific cod respond to such change in the past? Is there a connection to changes in the food web and mercury concentrations? Bulk isotope analysis cannot resolve these questions. Therefore we have applied compound specific isotope analysis of amino acids to a selection of Pacific cod samples from the Aleutians, allowing us to refine the emerging picture of this species in the area throughout time. Subsequently we place these results in a cultural context and integrate archaeological information regarding ancestral Unangax̂ resource use with our growing knowledge of the past ecology of Aleutian Island waters.

Long-Term Population Dynamics of Atlantic Cod revealed by Ancient DNA and Genomics

Oliver Kersten[1], Lourdes Martínez-García[1], Angélica Pulido[2], Giada Ferrari[1], Helle Tessand Baalsrud[3], Cecilia Helmerson[1], Marine Servane Ono Brieuc[1,4], Rachel Blevis[5], Jennifer Harland[6,7], Hans Christian Küchelmann[8,9], Anne B. Gotfredsen[10], Anne Karin Hufthammer[11], Marianne Vedeler[12], Christophe Pampoulie[13], Sissel Jentoft[1], Kjetill S. Jakobsen[1], James H. Barrett[14], Bastiaan Star[1]

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8. Knochenarbeit, Bremen, Germany
9. German Maritime Museum, Leibniz Institute for German Maritime History, Bremerhaven, Germany
10. Globe Institute, University of Copenhagen, Copenhagen, Denmark
11. The University Museum, Department of Natural History, University of Bergen, Bergen, Norway
12. Museum of Cultural History, University of Oslo, Oslo, Norway
13. Marine and Freshwater Research Institute, Hafnarfjörður, Iceland
14. Department of Archaeology and Cultural History, NTNU University Museum, Trondheim, Norway

Marine species are under threat by human exploitation and climate change. Knowledge of the long-term demography and genomic diversity of these species is crucial for their sustainable management and conservation. Our study focuses on the Atlantic cod (*Gadus morhua*), a species of immense economic and cultural value that has been exploited for millennia. We conducted a comprehensive analysis of ancient (n = 33), historical (n = 22) and modern (n = 370) Atlantic cod specimens from across the North Atlantic Ocean and adjacent seas to assess spatiotemporal patterns in genomic diversity and demographic history, marking the first whole genome analyses of fish specimens dating from c. 700 CE to the present. Sequencing the ancient specimens to ca. 7X fold coverage, we determined their biological origin through their genomic affinity to modern conspecifics. Our analyses of demographic history and genomic diversity revealed a genomic bottleneck between 700-1250 CE and modern times in several cod stocks, aligning with the expansion of marine fisheries during the medieval and early modern periods. Our findings offer a long-term perspective on the population dynamics of Atlantic cod and provide a deeper understanding of the scale of past resource exploitation delivering valuable insights for contemporary management strategies.

Poster Briefs

Humanities 4 the Oceans: Will Blue Humanities play a strategic role in Ocean Studies and Literacy?

Cristina Brito[1]

1. CHAM – Centre for the Humanities, NOVA FCSH, Lisbon

Maritime, environmental, and science historians and archaeologists, and other scholars from the humanities, have been addressing social, cultural and environmental changes and challenges of our days. They do so by integrating actors and entanglements, and by combining human and social sciences with natural sciences. Convergent or divergent ways of interaction with the ocean by different societies in various cultural and temporal contexts; exchanges, extractions, trade and consumption of aquatic resources; heritage, memory or practices had been questioned under the scope of the Blue Humanities. This contributes directly to our current knowledge about and actions on the ocean - it is vital for science for and literacy of the oceans. Through 4-Oceans' project we seek to use a global vision, addressing how mutual interactions have ensured the subsistence of humans and the resilience capacity of societies based on sustainable or unsustainable uses of the oceans, causing deep impacts on ecosystems composition, structure and function and leading to habitat degradation, species endangerment and extinction. We ultimately highlight the contribution of the Blue Humanities to inform future pathways that include the multiple agencies of the more-than-human ocean/planet.

Underwater Heritage in Biodiversity Conservation: A case study from Iceland

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1. University of Iceland, Research Center of the Westfjords.

2. Marine and Freshwater Inst. of Iceland

Throughout the centuries both Icelandic and European trading and fishing vessels frequented the waters around Iceland. Many ships were lost in the icy North Atlantic, but the exact number of shipwrecks is unknown. A recent study has mapped from written sources 916 shipwrecks in the period 1200 – 2000 but the same sources suggest that the number could be at least double. Currently the exact location of only 80 shipwrecks is known and most date to the 19th and 20th centuries. As government moves to meet the conservation goals of the COP15 agreement to protect 30% of the oceans by 2030 this underwater heritage has become of interest as an addition tool for conservation. In this study we map heritage sites that could be of significance for biodiversity conservation, evaluate how current legislation ensures their protection, use vessel monitoring data (VME) to examine if their in situ protection is sufficent, and finally, examine fishers perceptions to conserving these sites.

Words of the sea: the presence of the ocean in Portuguese proverbial speech in an historical perspective

Diogo Falcato[1], Cristina Brito [1]

1. CHAM- Centre for Humanities & DH NOVA FCSH, Lisbon

Historically, the Atlantic was appropriated by a romantic nationalistic view and reduced to the means by which a supposed “golden age” of Portugal was achieved in the Early Modern Period. In this way, the ocean has been ingrained by generations of historians as a ”mere pathway” with its historical agency, as well as of the (non-human) species who populate it, being largely stripped away. This has also led to the marginalization of different links that the Portuguese have longer held towards the sea, a place of nourishment and beauty but also of fear and danger. Even if historical records have proved difficult to obtain an insight into the minds of the people, oral traditions, specifically proverbs are still an underused tool for approaching the forgotten people. The sea and its inhabitants have been a common theme in Portuguese proverbial speech, many of which have survived into current vocabulary. In many cases, we find the same proverbs in sources dating back to the 16th and 17th centuries. This survival is evidence of the power of the sea and its imagery in the way people perceive and understand the world, as well as its central importance in Portuguese culture.

Marine Resource Use as a Form of Everyday Resistance during the Great Hunger: A Historical Archaeological Approach

Sophia Chapple[1], Emily Schwalbe[1], Rory Connolly[1]

1. Trinity Centre for Environmental Humanities, Trinity College Dublin

This paper seeks to challenge dominant narratives surrounding the Great Hunger in Ireland (An Gorta Mór, 1845-1852) by focusing on the often-overlooked aspect of marine resource exploitation. Traditional historiography of the famine typically centres on potato crop failure, British colonial policies, and resulting socioeconomic devastations. This narrative largely omits the daily survival strategies and forms of resistance employed by the Irish populace, especially their interaction with the marine environment. Drawing on historical archaeology and social history, this study explores how coastal communities employed the sea as a vital resource for sustenance, autonomy, and resistance against oppressive conditions imposed by crop failures and British colonial rule. We argue that while land-based resources were heavily controlled and often inaccessible to vulnerable tenant farmers, the marine environment represented a means of maintaining some degree of self-sufficiency and dignity in the face of hardship. By examining the archaeological record from this period, alongside contemporary accounts, we show how marine resources played a crucial role in the everyday survival of communities. In emphasising these maritime dimensions, this study not only challenges the dominant narratives of the Famine but also contributes to a more nuanced understanding of resilience and resistance in the face of large-scale crises.

Tuna fish traps in Algarve (Portugal): cathes and legal context under the portuguese monarchy of the early modern age

Brígida Baptista[1]

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From ancient times until at least the 1970s, tuna fishing was one of the Algarve region's greatest assets. The fishing traps set up every year on the high seas off the Algarve coast had a significant

political, economic, environmental and social impact on the region. During the early modern period, royal rights prevailed over this fishery, which resulted in a fruitful period in the creation of legislation to protect royal rights and generate profits for the Royal Treasury. At a local level, hierarchies were created and consolidated, such as the *Feitorias das Almadravas*, in Lagos and Faro. Historical sources show the wealth of this fishery, for example, in the value of the lease contracts and income from rights, but they are practically silent in terms of the numbers of animals caught. These figures were recorded, as mentioned in the documentary sources, in daily record books, which were kept by the *Feitor* of the aforementioned cities, but a significant part of this documentation has disappeared as a result of war and/or natural disasters. Through a preliminary analysis of this data, we will present an estimate of the number of tuna caught during this period.

Historic changes in isotopic signatures of Antarctic marine mammals over the past two centuries

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The establishment of the whaling station in 1904 at South Georgia had a remarkable effect on whale populations and Antarctic marine ecosystems until its closure in the 1960s due to dwindling whale stocks and subsequent whaling restrictions. Whaling and seal hunting in the southern parts of the Atlantic and Pacific has left an enormous legacy in museum collections. Studies of these collections provide an insight into the state of these environments when they were still effectively pristine and how they changed over time as a result of extensive human pressure. In this study, we analysed nitrogen and carbon stable isotopes of bone samples from two species of baleen whales (blue whale Balaenoptera musculus and fin whale B. physalus) and two species of seals (South American fur seal Arctocephalus australis and leopard seal Hydrurga leptonyx) deposited in the mammal collection of the Natural History Museum (London). By studying specimens from locations around the Antarctic Peninsula, a region experiencing one of the fastest rates of environmental change on Earth, we were able to describe the variation in isotopic signatures of key species of marine mammals from the 1850s to the present. This study is a part of SEACHANGE, an ERC-funded project quantifying the impact of major cultural transitions on marine ecosystem functioning and biodiversity.

Exploring the transformations of Tenerife's marine forests through time using archival records and local ecological knowledge.

Monica Mayorga Paz[1], Ruth Thurstan[1]

University of Exeter

My research explores the historical transformations of Tenerife's marine forests using historical archives and interviews with local stakeholders. Marine forests are characterised by shrub or canopy- forming species and play a vital role in ecosystems by providing resources and shelter for many marine organisms. Given their ecological importance, my aim is to understand historical shifts in their distribution and abundance over time, and uncover the drivers behind these changes. In Tenerife, marine forests encompass many species that form coral reefs, sponge aggregations, seagrass meadows, and algae forests. Given the high diversity of marine forest species in the island, I focus on the historical transformation of well-documented and recognizable species like *Gongolaria abies-marina*. Historically, this alga formed dense yellow matts along rocky shores of the northern and eastern coasts, but is now only found in small patches. My research also explores the interactions between people and marine forests over time, such as the exploitation of red algae *Gelidium* for agar production in the 1950s by the local community of Puerto de la Cruz. The findings of my research aim to contribute to the effective conservation and restoration of these important ecosystems.

Understanding Changes in the Composition and MTL of Great British Fisheries Landings, 1900-2010

Daniel Tucker Bailey[1], Ruth H Thurstan[1]

1. Centre for Ecology and Conservation, University of Exeter, Cornwall, UK

Fisheries have developed alongside human societies for millennia, shaping and altering ecosystems to produce the marine environment which exists today. Given that fisheries are of great importance to both global food security and the world economy, it is important that their long-term and historical impacts be studied in order to inform future sustainable management decisions. Here, we have used UK government reports to chart the development and impacts of Great British fisheries between 1900 and 2010, using change in the Mean Trophic Level (MTL) of landings as a proxy for ecological change. We have identified declines in MTL over multiple timescales, including declines of 0.25 since 1900 and 0.45 since 1950. We observe that the British MTL decline outpaced the global MTL decline of 0.2 which Pauly *et al* identified in 1998. However, we note that there are a variety of challenges in ascribing a mechanism – such as 'fishing down the food web' – to the Great British MTL decline, including the need to disentangle the various environmental, political and economic drivers of change in the composition of landings. Further study will be required to ascertain whether the MTL decline observed from the landings is reflected in the marine environment at-large.

Marine Exploitation Through Time: Unveiling Spatiotemporal Patterns and Implications for Human Development Over the Past Two Millennia

Eva Jobbová[1], Carolina Chong Montenegro[1], Francis Ludlow[1]

1. Trinity College Dublin

Within the increasing interest in the marine past and human exploitation of marine resources, brought on by the present ocean crisis, comparatively little attention has been paid to consequence of marine resource extraction for historical human and societal development. Overfishing and environmental stressors including marine heatwaves, pollution, acidification, and climate change, are spurring studies into species loss and establishing baselines to aid management and conservation. On the other hand, questions such as how seafood availability has affected historical

food security, demography, and health have not been sufficiently explored, and cannot be reliably answered without systematic comparisons. We present preliminary results of the Expert Review online questionnaire (part of the ERC-funded 4-OCEANS Synergy project), which surveys scholars and practitioners from many disciplines including marine environmental history, geography, historical ecology, zooarchaeology, and more, to distil and synthesize their assembled knowledge of the history of the exploitation of marine life globally. This knowledge will help us answer questions such as when, where, and how marine exploitation was of significance to human society during the last two millennia. The preliminary analysis of the data gathered show emerging patterns in spatial and temporal coverage of exploitation of species and methods used, levels of extraction and its sustainability, perceived drivers of change in exploitation over time, and changes in where the products of extraction were consumed and by whom.

Navigating the Temporal and Spatial Landscape of Black Coral's Ecosystem Services

Hannah Louise Green[1], Ruth Thurstan[1]

1. University of Exeter

Black corals (Antipatharians) serve as indicators of Vulnerable Marine Ecosystems and have been culturally valued for thousands of years worldwide. Despite black corals evident value to society, to our knowledge black corals ecosystem services have previously not been reviewed in the scientific literature. We aimed to establish the knowledge basis of black coral on four objectives: 1) distribution; 2) historical use directly and indirectly; 3) ecosystem services through time; 4) threats to these services' past, present and in the future. Evidence of the historic use of black coral for healing can be found dating back since the ancient Greeks and recently black coral has been used in the development of anticancer drugs in the pharmaceutical industry. Black corals are ecosystem engineers, forming thick forests which are habitat for many species, including commercial important fish species. With an increasing global population food security is critical, however, black coral forests are currently threatened by harmful fishing practises and (although understudied) some black coral species have been shown in laboratory experiments to have poor temperature acclimation. Additional research on the future impacts of climate change on black coral ecosystem services, and necessary conservation and restoration measures, is crucial for maintaining ecosystem services.

Threats to our ocean heritage: The intersection between natural and cultural heritage and the factors harming the marine environment

Charlotte Jarvis[1]

1. The Ocean Foundation

While the UN Decade for Ocean Science (2021-2030) has hundreds of endorsed ocean science activities, projects, and programmes relating to natural heritage and ocean biosciences, there are very few endorsements that focus on cultural heritage. This paper will discuss the UN Decade endorsed project, *Threats to Our Ocean Heritage*, which includes three books on UCH destruction from bottom trawling, potentially polluting wrecks, and deep seabed mining. They present a case study in how the UN Decade can be used to bring cultural heritage to the table with natural heritage and bring underwater archaeology to the ocean sciences. This paper focuses on risks to heritage from a variety of factors and discusses possible tools for mitigation and the UN Decade for Ocean

Science is discussed as a vehicle for adding maritime archaeology and UCH to the global discussions of ocean science. The paper will describe historic sites and impacts, but also offer recommendations to protect cultural resources showing how through aligning multidisciplinary ocean heritage mitigation strategies, we can engage and integrate the protection of UCH. Seabed mining in particular is a future threat to focus on as the regulations are still being moulded and there is great advocation for a moratorium.

Session IV

The Central North Atlantic Marine Historical Ecology Project, an Overview

George Hambrecht, Nicole Misarti, Arni Daniel Júlíusson, Steven Campana, Habiba Moshfeka, Mary Efird

The Central North Atlantic Marine Historical Project (CAMHEP) seeks to better understand the dynamics between people and Atlantic Cod in the waters around Iceland over the last 1100 years. A collaboration between the University of Iceland, the University of Alaska, Fairbanks and the University of Maryland, CAMHEP is utilizing historical archival data, archaeological data, and biochemical (SI and compound specific) data. On the marine end CAMHEP is generating size, age, and trophic data through the analysis of Atlantic cod bones and otoliths sourced from Icelandic archaeological sites. On the human side CAMHEP is utilizing historical and archaeological data to better understand catch levels as well as the importance of fish for subsistence as well as export over the last 1100 years. CAMHEP aims to synthesize these two aspects in order to better understand the complex relationship between people, climate and fish in this region. This presentation will give a general overview of the project and then present some of our preliminary results, introducing other members of CAMHEP who will present on specific aspects of the project.

Catch Estimates for Icelandic Fisheries from the 9th to the 29th century

Arni Daniel Júlíusson

Estimates for fish catch in Icelandic waters in the period from settlement in late 9th century to the present are important to any evaluation of the state of cod stocks. Work on such an estimate has been ongoing within the confines of the CAMHEP project, based on available sources and estimates. An important aspect of such an estimate is the size of the population of Iceland, and the present results of historical research depart in many ways from earlier estimates. New and improved estimates have become available for catches of foreign fleets in Icelandic waters as early as the 16th century. All this, together with other available material, is used in the reconstruction of catches presented in this lecture. The estimates are comprised of three parts: 1) Native catches of the Icelandic fishing fleet, for consumption within the country, 2) catches of the Icelandic fishing fleet after the 12-13th century for exports to other countries, and 3) catches of foreign fleets in Icelandic waters, transported to the home ports of the various nations. All this has been estimated to give a first-time overview of the fish catches in Icelandic waters from 877 to 1800 CE.

Dive into the Past: Exploring a Millennium of Marine History with Interdisciplinary Insights from Atlantic Cod (Gadus morhua)

Habiba Moshfeka, Steven Campana, Mary Efird, George Hambrecht, Árni Daníel Júlíusson and Nicole Misarti

Atlantic cod (Gadus morhua) is a cornerstone of North Atlantic fisheries and a vital player in global history that continues to shape economies, trade, and food resources. The Central North Atlantic Marine Historical Project (CAMHEP) employs a comprehensive approach, using $\delta^{18}O$, $\delta^{13}C$, and $\delta^{15}N$ bulk and compound-specific values of hundreds of cod cranial bone elements and otoliths from various sites in Iceland over the last 1100 years. Within this project, our focus extends to analyzing changes in trophic position, productivity, and foraging habitats of cod. As of the present, $\delta^{13}C$ and $\delta^{15}N$ signatures from 16 archaeological sites (n~500) exhibit significant variation ($\delta^{15}N$: 10.68‰ to 15.97‰; $\delta^{13}C$: -18.53‰ to -11.13‰), revealing distinct trophic behaviors in cod populations across the aquatic environments represented by these archaeological sites. In tandem with the bulk SI data, this research project also delved into oxygen isotopes from cod otoliths (n~180) to explore changes in size and growth patterns due to fishing and temperature changes. This multi-proxy approach will provide intriguing insights into the dynamic nature of cod productivity fluctuations and trophic interactions across different temporal and spatial dimensions.

Forklength of Atlantic Cod (Gadus morhua) from Icelandic Archaeological Sites Revisited

Mary Efird, Habiba Moshfeka, Steven Campana, Arni Daniel Júlíusson, Nicole Misarti and George Hambrecht

This presentation will explore and discuss changes in archaeological Atlantic cod remains that have been used in the past to investigate the commercialization of Icelandic fisheries. It has been argued that this commercialization is reflected by the standardization of fish skeletal remains in the archaeological record. The argument is that before the advent of fishery commercialization in the 13th century, Iceland's inter-regional trade of dried fish products used various gadid species to produce both flat-dried and round-dried fish products. By the 13th century, Icelandic fishbone assemblages were dominated by Atlantic cod. The live-lengths estimated from these cod bones commonly fell between 60 to 110 cm, which is ideal for producing stockfish. This pattern of standardization in Icelandic faunal assemblages and its connection to commercialization was first reported using zooarchaeological evidence from a handful of Icelandic sites. The Central North Atlantic Marine Historical Ecology Project has since collected live-length data from cod remains found in over a dozen Icelandic archaeological sites, spanning different time periods and geographic areas. This presentation will discuss CAMHEP's live-length data and how the patterns it exhibits either align with or deviate from previous conclusions about the relationship between standardized fish selection and the commercialization of Icelandic stockfish production.

Poster Briefs

Long-term extractions of pinnipeds in Southern Africa: cross disciplinary approach and methodological challenges

André Carvalho[2], Ana Roque[1]; Diogo Falcato[2]

1. Centre for History of the University of Lisbon, FLUL
2. NOVA FCSH, Lisbon

This presentation addresses the methodological challenges inherent in reconstructing the extensive history of the capture and extraction of seals and sea lions in Southern Africa. Rooted in a carefully crafted methodological framework, our approach adopts a two-pronged strategy: an exhaustive literature review intertwined with targeted analyses of written historical data and tangible material evidence. This type of research calls for interdisciplinary collaboration, drawing upon a spectrum of disciplines spanning natural and human sciences. Historically, these disciplines operated in isolation when attempting to construct the narrative surrounding the history of these animal species and their multifaceted uses. As such, there is a pressing need to define a methodological framework that aligns with the specific inquiries posed by each disciplinary domain, while also accommodating the emergent complexities inherent in a comprehensive and holistic analysis. By addressing these methodological challenges, this presentation seeks to bridge the gap between disciplines and foster a more integrated approach to understanding the historical dynamics of seal and sea lion exploitation in Southern Africa.

The Human Marine Horizon: Estimating Historical Coastal Populations on a Global Scale, 1-2020 CE

John Nicholls[1], Cianna Devitt[1]

1. Trinity College Dublin, Centre for Environmental Humanities

We establish historical time series of global Human Marine Population (HMP) estimates based on existing research and statistical information spanning over two millennia in the Common Era. We formulate a multifaceted process to attain “ground-truthing” of established historical human demographic information, enabling a richer, more deeply granular and more robust series of temporal and locational data series to provide baseline information to inform local, regional and global human marine population data. Uniquely, we develop a Human Marine Horizon (HMH), a set of informed proxy values that indicate differentials between historical human marine populations and historical human hinterland populations. We determine these estimates based on combinations of available coastal settlement numbers, human marine exploitation values, maritime socio-economic and geo-political trends, and social-science research into human marine traits and patterns such as seafood and non-food consumption.

Global warming may cause the return of Last Interglacial (Pleistocene) warm guests into the Mediterranean Sea

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4. Department of Earth Sciences, University of Florence, Florence, 50121, Italy.

The Mediterranean Sea is a marine biodiversity hotspot already affected by climate-driven biodiversity collapses. Its highly endemic fauna will be at further risk if global warming triggers an invasion of tropical Atlantic species. Here, we combine modern species occurrences with a unique paleorecord from the Last Interglacial (135–116 ka), a conservative analogue of future climate, to model the future distribution of a subset of tropical West African mollusks, currently separated from the Mediterranean by cold upwelling off north-west Africa. We show that already by 2050, under an intermediate climate scenario (RCP 4.5), climatic connectivity along north-west Africa may allow tropical species to colonize a by then largely environmentally suitable Mediterranean. The worst-case scenario (RCP 8.5) leads to a fully tropicalized Mediterranean by 2100. The tropical Atlantic invasion will add to the ongoing Indo-Pacific invasion through the Suez Canal, irreversibly transforming the entire Mediterranean into a novel ecosystem unprecedented in human history.

Species-distribution model for sardine (*Sardina pilchardus*) on the Portuguese coast: A look at historical trends

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2. Zoological Society of London (ZSL), Regent's Park, London, NW1 4RY

This poster presents a species-distribution model of sardine population along the Portuguese coast over the past three decades (1992–2022). It is being developed as part of the "Fishing Architecture" research project, which is assessing the historical connections between fish and the built environment. The hypothesis is that the development of infrastructure for handling and processing fish, such as landing facilities and canning industries, is influenced by fluctuations in natural fish populations. A better understanding of the patterns and dynamics of fish distribution is thus essential if we are to determine and characterize the full set of relationships between socio-ecological environments and architecture. To achieve this, we employed a Generalized Additive Model (GAM), using the following as variables: i) physical descriptors (water temperature, salinity, water currents, and climatic indices—NAO and ENSO); ii) water quality (nutrients); iii) social descriptors (landings, consumption patterns); and iv) biological descriptors (primary production, predation). By crossing the model results with the historical data on sardine distribution and abundance, we were able to provide insights into medium /long-term trends and better understand the remarkable interannual variability of sardine stocks, which affect fishing efforts and, ultimately, the buildings required to meet the needs created by this activity. The species-distribution model based on recent data will be used as a tool to hindcast the history of sardine populations.

Next stop, South Seas. The beginning of sperm whale hunting in the South Atlantic (18th century)

Carla Vieira[1], Nina Vieira[1]

1. CHAM – Centre for the Humanities, NOVA FCSH

In November 1772, Aaron Lopez, a whaling entrepreneur in Newport, R.I., instructed Captain Lothrop to proceed with the brigantine *Leviathan* to the Southern Seas, looking for sperm whales. On the second attempt, Lothrop reached the coast of Brazil and, together with his crew, was imprisoned by the Portuguese authorities, who ended up using these whalers' know-how to introduce a new branch of whaling there. In September 1779, the British consul in Lisbon, based on the testimony of two *Leviathan* crew members, claimed that this voyage had opened the floor to the thriving sperm whale hunting in the South Atlantic. Based on research on the earliest sperm whaling voyages in the South Atlantic (1772-1776), in this paper we will address 1) the circumstances that motivated a change in the range of sperm whaling from the North to the South Atlantic, 2) the evolution of the catch effort in the 1770s-1780s, 3) quantities of spermaceti and oil extracted, and 4) perceptions about animals' behaviour in response to their capture. Considering that the history of sperm whale hunting is usually told from 1780 onwards, our work reveals the inaugural period of one of the most impactful operations in the history of whaling.

Posters

Archaeological Records: Prehistoric nearshore fishing in the Strait of Gibraltar and the Alboran Sea (Spanish Coasts)

Elena Pérez-Rubín[1] Juan Pérez-Rubín[1]

1. Centro Oceanográfico de Málaga, Instituto Español de Oceanografía (IEO, CSIC)

In this geographical region, transition between the Atlantic and the Mediterranean, several of the prehistoric societies established exploited marine resources very different from the current ones, which were drastically changing in the successive cycles of cooling and global warming of the sea and the atmosphere. During the Pliocene-Early Pleistocene-Holocene various communities exploited marine resources as shown by the excavations and geo-archaeological studies conducted in different caves in the region. Particularly in the cave of Nerja (Málaga), in which the records of marine fauna are among the most interesting in Europe, with thousands of invertebrate remains, fish and seabirds. Its inhabitants captured, with harpoons and hooks, species that are currently typical of the North Atlantic: the extinct great auk (*Pinguinus impennis*), *Phoca vitulina*, and fish of the Salmonidae and Gadidae families: *Salmo salar, Salmo trutta, Gadus morhua, Melanogrammus aeglefinus, Pollachius pollachius* and *Pollachius virens*. On the other hand, during the Upper Magdalenian, it is also documented, indirectly, in the same cave the consumption of whale meat and fat of the today endemic Antarctic species *Eubalena australis* (explained in relation to the Antarctic sea-ice expansion during the Last Glacial Period when these whales could have migrated to the Northern Hemisphere, and reached southern Spain).

Fluctuations: the very essence of marine populations and their ecosystems in Spain

Juan Pérez-Rubín[1], Elena Pérez-Rubín[1]

1. Centro Oceanográfico de Málaga, Instituto Español de Oceanografía (IEO, CSIC)

Although there is literature that blame changes in marine fauna and flora exclusively on negative human interactions, we need to take into account a centuries-old environmental history, characterized by climatic-oceanographic changes and fluctuating episodes with cooling *vs*. warming cycles that affect marine ecosystems. It is necessary to clarify, for target species, the natural and/or human causes that have been responsible for their periods of super-abundance and absence or extreme scarcity throughout history. In Spain we have two paradigmatic examples during the period 1525-1575 for species well known in its waters: that period coincides with the maximum catches in history of bluefin tuna in the traps of the Gulf of Cadiz (average catch 58,600 tuna/year), contrasting with a dramatic sardine crisis in Galicia. Contrary situation at the end of the 19th century when an oceanographic vessel took 5 hours to cross a school of Galician sardine. On the other hand, since the Iberian Peninsula is a transition region between temperate and subtropical latitudes, the presence of exotic species of tropical origin in their waters is useful as indicators of oceanic warming. In different reliable Spanish sources from the 18th-19th centuries we find news about the Northward movement by diverse tropical species that include fish and macroalgae.

Wednesday 26th June

Session V – Exploitation, coastal communities and interdisciplinary approaches I

Unraveling the historical landings trends of batoids: looking to the past to improve management and conservation of data-poor fisheries

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Batoids (rays and skates) are among the most threatened marine species. Artisanal and industrial fisheries increasingly capture batoids, contributing to population declines globally. In the Mexican Pacific (MP) artisanal fisheries, batoids represent ~20% of elasmobranch catches, and guitarfishes are a significant part of the landings. Eight guitarfish species of the Rhinobatidae and Trygonorrhinidae families are distributed within the MP, and six species were recently listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to regulate their international trade. However, data deficiencies on landings time series and fishing effort challenge their effective management and conservation. We undertook a reconstruction of historical landings of artisanal fisheries for the eight guitarfishes in the MP based on an exhaustive review of extant literature, historical archive records, and alternative data sources. We also summarize existing biological and ecological information to estimate local extinction risk and to identify priority species to focus future research and assessments. Findings here provide a baseline to advise for provisions for CITES implementation in a data-poor fishery context and for developing future management and conservation strategies.

How can a historical analysis of a small-scale multi-species fishery help advance its sustainable management?

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The Gulf of California (GC) is Mexico's most productive fishing region, with over 100 years of small-scale fisheries operation' history. Despite the socio-economic importance of these multi-species fisheries, the population status of many target fish species is unknow due to the lack of precise and reliable fishing statistics per species and limited biological data, making sustainable management difficult. In this study, we made a historical analysis of the leopard grouper (Mycteroperca rosacea), an important species in the GC small-scale multi-species fishery, to reconstruct their historical catches and evaluate their population status. We carry out extensive bibliographic research to identify historical records of the leopard grouper fishery. We reconstructed a time series of 50 years of the leopard groupers' landings and evaluated their population status using a catch-based method for data-poor fish stocks. The results show the first historical landing trends and status of a commercial species that can serve as the baseline for future management for the species and other species in the world in a data-poor fisheries situation. We discuss the historical dynamic of the fishery of the leopard grouper and its management implications.

Combing users´ perception and landing data for fishery management in a data-limited country, Cabo Verde, western Africa

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Cabo Verde's small-scale fisheries, in West Africa, face strong challenges related to fisheries management, resource sustainability and climate-resilience. Within a data-limited context, local ecological knowledge (LEK) is crucial for assessing past fisheries states. However, LEK still tends to be dismissed by managers due to the 'Shifting Baseline Syndrome' (SBS), a phenomenon wherein human perceptions of biological systems change over generations, influenced by the loss of experience about past conditions. In Maio island, one of the poorest islands of the archipelago, increasing catches by industrial and semi-industrial fleets as well as destructive practices are threatening the food security of artisanal fishing communities. In this study, we aimed to evaluate the changes of Maio's artisanal fisheries status by combining official landing data with novel information from fisher and fishmonger's perceptions. We tested evidence of SBS by comparing perceptions of different age groups with landing data from 1995-2019. Our findings highlight the impact of SBS on users' perceptions, which is also influenced by local context even within a small island with low fishing technique diversity. Notably, LEK not only validated trends observed in official data but also offered additional insights into the past fishery state of Cabo Verde.

Historical data availability and needs of Mexican fisheries

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Traditional fisheries management requires long-term data to assess adequately the health of the stocks. Developing countries are characterized by their complexity and lack of long-term catch records. Using Mexico as a case study, we aimed to describe data availability, timescale, researchers' and managers' data needs, and the pathways to integrate these data into management. In order to understand the characteristics, history, missing information and available data for local fisheries, twenty-eight managers and researchers were interviewed. We found that decades of government-led monitoring produced long-time data series, but most of these data are either stored in archives or lost or not available to the public. Current public data include the National Fisheries Chart and catch records for some fisheries since the 1980s. There is a consensus among researchers and managers that important missing information includes historical changes in fishing effort, catch composition and sizes, as well as socioeconomic information such as the number of fishers, their income and costs of fishing trips. The areas of opportunity to include this type of data include assessments, certification processes and voluntary fish refugia. This work highlights the kind of historical information required to improve fisheries management.

Spatial scales and the consumption pattern of marine resources in West Jutland, Denmark before and after the breakthrough of modern sea fisheries

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This paper explores how in rural Western Jutland, the consumption of marine products underwent a dramatic transition from the 1850s-60s and into the 1920s. An unusually rich set of household records from the manor house of Nørre Vosborg enables a reconstruction of the marine diet of a large, socially segregated household in the sparsely populated, rural, West Jutland. Located on the banks of Denmark's second largest river, Storåen and the Nissum Fjord estuary, the mid-19th century diet of the manor house was surprisingly diverse, with lots of local freshwater species and flounder, yet with great seasonal variation. In contrast, by the mid-1920s, the same household primarily ate saltwater species caught in the open sea and purchased on the market. Several studies have investigated how West Jutland Danish seagoing fisheries were greatly transformed with the advent of decked vessels and motor propulsion in the decades around the turn of the 20th century. This transition has not hitherto been explored from the point of view of the end consumer. Through this change of perspective, the paper highlight the marine resource depletion and the habitat destruction occurring in the estuary, while the sea fisheries flourished.

Mapping the spread of industrialised bottom trawling and its ecosystem impacts across Great Britian and Ireland

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Prior to the introduction of national fisheries statistics in the late 19th century, bottom trawling had established itself as a widespread and significant fishery in Great Britian and Ireland. However, descriptions of how early fleets of bottom trawlers developed, and their associated impacts to sensitive or rare marine habitats, are poorly described and synthesised. In this study, we make use of sources such as royal commissions, parliamentary papers, personal accounts, as well articles published in the local and national media of the day, to catalogue the emergence of industrial trawling fleets, and describe their evolution over the 19th and early 20th centuries. We gather information on the size and extent of such fleets, the advent of new technologies, the exploitation of new trawling grounds, and where possible, the ecological implications of these developments on marine ecosystems. The results of this study are expected to deepen our understanding regarding the scale and extent of bottom trawling prior to and during the industrial revolution, and to illustrate how past marine ecosystems and features were increasingly impacted long before the fleets of the late 20th century.

Session VI – Exploitation, coastal communities and interdisciplinary approaches II

Investigating the history of Sussex kelp habitats and their impact on local communities

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Understanding long-term change within marine ecosystems requires an interdisciplinary approach to research, which employs various approaches from the historical, ecological, and social disciplines. This enables a deeper understanding of past human-ocean interactions, past ecosystem quality and function and the scale of which humans have impacted these environments. This is particularly important for marine ecosystems that are difficult to survey, including kelp forests. Historical data on kelp forests are urgently needed to establish accurate baselines for recovery, and to understand the drivers, and sociocultural implications of historic kelp decline. With a lack of long-term ecological datasets available, mixed-method approaches are becoming increasingly important to fill these gaps. Historically, kelp habitats stretched ~30km of coastline in Sussex, but by the mid-1980s, an estimated 96% of habitats had been lost. Little is known about the historical extent of kelp, its densities, and the timings and drivers of its decline along this coastline. Additionally, the influence that kelp, and its decline, has had on local communities and fisheries also remains unknown. My PhD uses oral history and semi-structured interviews, grey literature, and ecological and spatial data, to provide a more representative baseline of the distribution and dynamics of these habitats, and understand their social-ecological significance through time.

Resilience over a lifetime of change in marine and coastal livelihoods

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Coastal communities are at the forefront of rapid and radical changes today, but also have decades and generations of experiences responding to past changes. Despite increasing awareness of the significant societal and environmental changes experienced by coastal communities, little research has been conducted on individuals' ability to absorb, adapt, or transform in response to these changes (their "resilience") over their lifetime working in the marine environment. We aim to understand how individuals living and working in coastal communities have responded and adapted to multiple change events over their lifetimes. This qualitative study uses sixty-three oral history interviews undertaken with those who have lived and worked in the marine environment in four coastal communities in Devon and Cornwall, England. The oral history dataset draws on flexible coding and thematic analysis to explore the ebb and flow of resilience to change and change events through individual lives. Ongoing analysis is used to better understand resilience throughout different life stages, mapping change and resilience to individual timelines to identify characteristic patterns of resilience. We conclude by providing a preliminary account of resilience to change over a lifetime, to improve understanding of resilience and adaptation processes at the individual, multi-decadal scale.

Seaweeds as part of plant ecosystemic services in the past: the case of coastal Atacama

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Plants in coastal areas are not only important for preserving the ecological balance but have historically been crucial for supplying populations with a variety of ecosystem services. Historical, ethnographic and archaeological records demonstrate widespread usage of plants as fuel, food or medicine and as raw and building materials. Costal socioecological systems show subsistence strategies in which both terrestrial and marine resources are used. In coastal deserts such complementarity becomes unique because the lower vegetal cover might force human populations to find alternative ways to supply those ecosystemic services. In coasts, but more specifically in scenarios such as coastal deserts, seaweeds are a valuable resource that contribute to the plant capital. Seaweeds have been occasionally documented in archaeological sites with outstanding preservation conditions, though they have not received much attention from an archaeological standpoint. Coastal archaeology is currently increasing interest in these resources as a substantial portion of the archaeological record of coastal areas that might be routinely disregarded, recognizing its value as an ancestral resource that might explain coastal economies in the long-term. We present our projects addressing this topic through analysis of ethnographic data together with results from our archaeological research in the coast of Atacama in Chile.

Indigenous and European Subsistence in Colonial Amazonia: Patterns of Appropriation, Exploitation and Consumption of Turtles from the 16th to the 18th centuries

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Turtles are historically one of the most important animals for humans in the Amazon. Commonly consumed by different indigenous groups, mostly settled along aquatic interfaces, turtles and their eggs became equally central for Europeans since their arrival in the 16th century. Turtle's meat and eggs were appreciated food sources, and their fat and oils were a good supply for lightning. Lying on Indigenous knowledge and practices to survive in the Amazon, from coastline to hinterlands, the expanding Portuguese and Spanish settlements in the region started to put increasing pressure on the exploitation of aquatic animals, consequently impacting their population. This is particularly evident among turtles, easily captured due to their slow movements and natural habitat near the rivers. Within this context, the Portuguese religious missions and military quarters were their main consumers, having explored preexisting indigenous fishing communities and structures for their maintenance. This paper will present research results on turtle populations in the Amazon during the modern period by considering cultural, social, and political contexts based on historical resources and literature review. This study aims to explore the impacts of the European presence and interference in the Amazon during the colonial administration and identify different patterns of turtle exploitation.

Life on the Edge: New Perspectives, New Insights from LOTE

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The ***Life on the Edge (LOTE)*** is an interdisciplinary UKRI project which seeks to undertake innovative archaeological research into the Late Palaeolithic (20,000 to 10,000 years ago) landscapes that existed around the world and were submerged by sea level rise following the end of the last glaciation. Sea level rise was a global phenomenon, and this talk will provide the results of research across Europe and off the American coast where the development of new methodologies has been implemented in support of site location and to explore what these now submerged landscapes can tell us about the impacts of sea level impact on human occupation in the past. As offshore global development accelerates, the project will use its global remit to to assist government and developers in identifying and managing areas of the seabed have most potential value for Late Palaeolithic archaeological preservation.

Speed Talks

Logbooks, Whale Catches and Oceanic Climates: Reconstructing Maritime History with Herman Melville's Moby Dick (1851)

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This paper discusses a GIS mapping of Herman Melville's Moby Dick, or, the Whale, in conjunction with whaling logbook transcriptions, the United States Exploring Expedition (1838-1842) and other data related to nineteenth century American whaling, scientific and naval journeys. As a novel, Moby Dick is composed of 135 chapters- each offering a unique eco-tonic or maritime dioramic space, a sense of place, personage, geography of a ship or ecosystem, that form the narrative chain of a fateful whaling voyage starting with Ishmael's arrival in New Bedford in Chapter II to the Pequod's sinking in the South Pacific after encountering the Great White Whale and Ishmael's rescue by the Rachel in the novel's Epilogue. Utilizing MAXQDA/A.I., software, corpus linguistics, and other techniques, this paper draws upon practices in historical geography, GIS and textual analysis to map and incorporate Moby Dick's narrative within the context of nineteenth century American whaling expeditions in the Atlantic, Indian, and Pacific Oceans. Grounded in "eighteenth-century antiquarian approaches to geography, history, people, culture, and place"[1], the methods deployed in this paper outline GIS approaches to spatially analyze and re-interpret the ""textuality of history, and historicity of texts," with the recognition that Melville's biblical and classical allusions and incorporation of nautical charts, data, scientific records, logs and other documents "cannot be abstracted from the historical context" of the United States' continental, and subsequent global expansion, in which Moby Dick was "produced and consumed"[2].

The historical knowledge about marine resources in Portugal (16th-18th centuries).

Patrícia Catarina Sanches de Carvalho[1] ,Cristina Brito[1]

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Early modern historical sources about Portuguese marine resources are heterogeneous and dispersed. Different types of information have been compiled by different actors in different records, from letters, written surveys and inquiries, natural history treatises, travel literature and poetry to recipes books. This diversity provides different perspectives about marine resources, from species description, uses and tastes, to distribution patterns and seasonality. In this paper we aim to present the different typologies of sources and it's potential for the study of Portuguese halieutic resources, including the state of marine ecosystems and populations. We will also address the circulation of information in the early-modern period, its motivations and interests. Our approach includes a compilation of different records, comparing types of information provided by each and integrating them in their broader context. More than 100 types of halieutic species were collected and compared, including mainland Portugal and islands.

The Ecological Relevance of Small-Scale Fisheries in the North Atlantic: A Literature Review

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Small-scale fisheries have historically received less scientific and policy attention than their industrial counterparts. However, in recent decades, there has been a notable increase in academic publications, coupled with the emergence of global policy instruments dedicated to the small-scale sector and coordinated efforts to comprehensively assess the global significance and impacts of small-scale coastal fishing. This significance is acknowledged in economic and sociological terms, owing to the substantial reliance, both direct and indirect, that numerous individuals have on this sector. According to the Food and Agriculture Organization of the United Nations, small-scale fisheries represent approximately 80% of the European Union's fishing fleet and contribute significantly to the overall fishing effort. Additionally, small-scale fishing is recognized as a contributing factor in the preservation of local biocultural diversity, as stated by the Florence Declaration on the Links between Biological and Cultural Diversity in 2014. This article presents the findings of a narrative literature review focused on small-scale fisheries in the North Atlantic European region. The study examines the period from 1885 to 1939, predating the substantial post-World War II industrialization. It investigates the interconnections between material culture and fishing practices, along with their effects on ecosystems, to evaluate the ecological relevance of small-scale fisheries. The thorough examination of the historical, architectural, and ecological aspects of small-scale fisheries in the North Atlantic European region within the specified timeframe presented in this article enhances our comprehension of their multifaceted importance, thereby filling a critical gap in the existing research landscape.

Learning from the past: understanding maritime heritage to make the world a safer place: Potentially Polluting Wrecks

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Lloyd's Register Foundation supports research, innovation, and education to engineer a safer world. Ocean safety is a particular focus and we aim to direct funding to support effective and long-lasting interventions to address the most pressing challenges across ocean sectors, infrastructures, and communities. The *Learning From the Past* programme works to engage with all types of evidence about past endeavours that can help inform todays safety challenges. We work with academic experts and form coalitions for change, collaborating with unilateral institutions on complex regulatory issues as well as seeking out evidence associated with groups that are underrepresented or excluded from conventional narratives about our maritime past. A historical perspective engages new audiences and helps to create well-informed ocean citizens. With the launch of the UN Decade of Ocean Science for Sustainable Development there has never been a better time to contribute lessons from the past to global efforts to secure the future we want. This paper will explore the case study of Potentially Polluting Wrecks, and how our approach is helping to convene the stakeholders and historic evidence needed in our programme: "*Towards a Global Framework for the Near and Long Term Assessment, Intervention and Sharing of Data for Potentially Polluting Wrecks".*

The exploitation of marine resources in the Southeast Pacific in the late 18th century: a global challenge.

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In January 1790, the English whaling frigate Emelia entered the Great Ocean and began its search for sperm whales in waters "dominated" by the Spanish. It will soon be followed by other ships of the same flag and other French and American ships with the same purpose. The Spanish authorities, concerned about this "invasion", take their measures, generating a series of conflictive events that have an impact on the exploitation of marine resources in these seas. The Spanish intercepted the ships, interrogated their captains and crew members, collect a significant amount of information about the operations of whaling ships at the end of the 18th century. Can we learn anything about whaling operations in the Southeast Pacific from the documents jealously gathered by the Spanish authorities primarily out of "fear of smuggling"? Do the data collected allow us to say anything substantive about the relations between the European powers that crossing the southern seas at the end of the 18th century? Is it possible to determine the real impact of these whaling operations on cetacean populations at that time? This work aims to advance the answers to these questions.

Session VII – Journeys through Time

A metagenomic journey through the Holocene in the North Sea:changes in marine ecosystems using ancient environmental DNA

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The North Sea has undergone significant anthropogenic pressure, resulting in fish stock depletion and habitat loss. Nevertheless, in southern Scandinavia, archaeological evidence indicates that hunter-gatherer-fisher communities intensively exploited marine resources in the Late Mesolithic (between 7,600-5,900 yr BP). This was followed by a dietary shift to terrestrial foods, coinciding with the arrival of farmers to the region and the start of the Neolithic (c. 5,900 yr BP). However, our understanding of marine biodiversity during this transition is limited and primarily based on the remains of marine animals, often found within shell middens. Ancient environmental genomics has shown to provide valuable insights into the long-term dynamics of marine ecosystems. In this work, we present preliminary metagenomic results obtained from three marine sedimentary deposits from the Jutland peninsula (Denmark): Kalø Vig, Limgord, and Vejle Fjord. We sequenced ~2.5 billion DNA models as well as the zooarchaeological evidence from known Mesolithic and Neolithic archaeological sites in Denmark. Our findings demonstrate how ancient environmental DNA can significantly contribute to the understanding of marine biodiversity dynamics and their complex Interactions with cultural shifts.

Illuminating marine food web structure and function of the East Coast of Scotland in the 1890s using landings data

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Marine ecosystem models have emerged as tools to simplify and enhance our understanding of the processes occurring at various levels within ecosystems. Higher trophic level models, such as Ecopath with Ecosim (EwE), investigate marine food webs from primary producers to top predators. EwE is the most widely used modelling approach, primarily due to data availability and its capacity to address a range of research and policy questions. However, due to data limitations, uncovering the historical state of marine ecosystems remains a challenge, crucial for understanding changes in response to anthropogenic stressors. We developed a mass-balanced Ecopath model with 20 functional groups and 4 fishing fleets to represent the East Coast of Scotland in the 1890s, based on a comprehensive dataset of species- and gear-specific historical landing statistics. The results indicated that the ecosystem's structure and function were predominantly maintained by trophic interactions. The functional groups representing large predatory fishes were particularly important groups in maintaining the ecosystem functioning in the 1890s. Consequently, this model highlighted the potential of the usage of historical landings in EwE models and can provide the necessary baseline, mass-balanced initial conditions, for further time dynamic modelling effort.

Historical Literature Review of Global Commercial Fisheries, 1-1900 CE

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This presentation highlights key findings from the first global literature review of pre-industrial historical fisheries conducted by the 4Oceans project from 2022-2023. The survey aimed to evaluate trends across the existing historical scholarship (excluding archaeological studies) on global fisheries and asses where gaps in our knowledge persist. In this paper, we detail the methodolgy used for the review, which involves conducting bibliometric analysis on collected metadata. Our findings provide insights into the extent of knowledge regarding historical fisheries in the Pacific, Atlantic, Arctic and Indian Oceans. We also outline when and where written accounts of commercial fisheries appeared in human history. from the earliest mentions of marine exploitation in classical literature to the onset of more extensive record keeping inthe nineteenth century. These findings have immense value in informing the direction of future historical research into pre-industrial fishing and contribute to our understanding of how societies have exploited marine resources over the last two millennia.

Iberian Fish Assemblages on the Very Long-Term

Sónia Gabriel[1], André Tavares[1]

1. Porto University

Fish assemblages retrieved from archaeological contexts with wide spatiotemporal ranges are a rich source of cultural, environmental, and biological information. The shores of Iberia have been explored for several millennia, an usage that has left many traces and an array of fish remains. Through the quantification of the distribution of bone remains according to species, large volumes of this data can be used to identify regional differences and to track diachronic changes in fish populations. Despite the bourgeoning body of information accessible for Portugal and Spain, data is scattered. This paper will present the development of a database collating data for the Iberian Peninsula, spanning from 97 000BP to today. This very long term overview nourishes the debate on how past societies have coped with marine-resource availability, as well as when and where did marine resources have become of major significance.

Living Bones: a cross-methodological approach to the study of marine animals in the past.

Joana Baço[1], Nina Vieira[1], Cristina Brito[1]

1. 1ERC Synergy Grant 4-OCEANS "Human History of the Marine Life", CHAM - Centre for the Humanities & UNESCO Chair "Ocean's Cultural Heritage", NOVA FCSH.

Bones are often viewed as the remains of a deceased body. However, despite the lack of life in the body, bones can still provide valuable information. Our methodological approach involves studying the bones of different marine animals, revealing untold stories. The ERC Synergy Grant 4-Oceans project 'Human History of Marine Life' utilises techniques and methods from history, archaeology, and digital humanities to gain new insights into marine animals and their osteological remains. Our approach includes sampling for future ancient genome analysis, photogrammetry, 3D modelling, and pop culture and artistic manifestations review such as television series. Through these methods, we aim to breathe new life into this cultural and natural heritage. This is a narrative of an interaction, not always peaceful or linear, but always catalysing change and adaptation, evoking both fear and enchantment.

Speed Talks

Histories of the not too distant past: trends in Environmental Sustainability of UK Seas 1992-2022

T.A.Stojanovic[1]

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Marine policy for seas surrounding the United Kingdom maritime jurisdiction has evolved significantly over the period 1992-2022 with a general increase in policies and environmental duties. Furthermore, since the early 2000s, state of the ocean reports at multiple scales from OSPAR Quality Status Reports for the North Atlanitc region, down to UK Charting Progress and Marine Assessments for Scotland, Wales and Northern Ireland, and more local state of the coast reports, have given rise to multi-disciplinary analysis of status and trends- raising hopes about a more systematic research programme to assess sustainability. Nevertheless, when we consider attributing causation to management interventions, challenges remain to link management outputs to environmental outcomes. In this paper, I report on trends in key sustainability issues of overfishing, marine litter, ocean temperature and habitat loss. Focussing on those issues, I review the challenges of developing a critical narrative, which can account for the roles of agents, actions, baselines, goals, status, judgements about impacts of policy and verdicts on trajectories of sustainability. In conclusion I consider the philosopher Paul Ricoeur's notion of 'emplotment', and its productivity in helping us to overcome some of the challenges of constructing such a narrative.

A sea of doubts. Perceptions and Representations of the Pacific Ocean: The Mariana Islands.

Noelia Villena Rodríguez[1]

1. Pompeu Fabra University

In the late medieval and early modern period, the different explorations and the new knowledge that was acquired about the unknown maritime environment of the Atlantic Ocean forged perceptions and an imaginary which was consolidated in the representations we find of it. Thus, the arrival to a "new" continent and the sighting of a "new" sea, called the South Sea, prompted expeditions. Therefore, the first European fleet to enter the Pacific Ocean was Magellan's fleet and the Mariana Islands were the first inhabited territories sighted in 1521. Consequently, when studying the role played by this archipelago during the Spanish colonisation of the Pacific, several aspects must be taken into account. In this presentation we are going to focus on: unpacking and analysing the different perceptions and representations of this territory through logbooks and maps made in the period of contact and early modernity (16th -17th Century) (1); understanding the importance that this settlement acquired (2); analysing the appropriation of its maritime environment and its use by the expeditions, how these served to make the Mariana Islands, and their path through them, essential for the success or failure of the transpacific route of the Manila Galleon (1565-1815) (3).

KEYNOTE

Unveiling Sawfishes Presence in the Yucatán Peninsula through the Synergy of Fisher's Local Ecological Knowledge and Interdisciplinary Science

Nadia T. Rubio-Cisneros[1] (Keynote speaker), Ilse A. Martínez-Candelas [1,3], Diana Ordaz-García [1,4], Juan C. Pérez-Jiménez [5], Nayeli Jiménez-Cano [6], Jeffrey B. Glover [1,7], Brianna K. Montes-Ganzon [1,8], Gabriel Ruiz-Ayma [1,2], José I. González-Rojas [2]

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Knowledge of sawfishes is still scant in Latin America. *Pristis pristis* (largetooth sawfish) and *Pristis pectinata* (smallthooth sawfish) are critically endangered. Coastal landscapes in the Yucatán Peninsula (YP) were historically inhabited by these species. Our interdisciplinary study gathered data from 290 fishers' Local Ecological Knowledge (LEK) surveys with geospatial elements, reviewed 74 literature sources, and examined available archaeological data. Findings indicate the past prevalence of sawfishes, their cultural significance to coastal societies, and their contemporary absence from historically inhabited coastal areas. Juvenile sightings were exclusively documented by elder fishers, with only two recent narratives reporting incidental catches five years ago. Geospatial analysis identified 52 sites in the YP where sawfishes were once common. These outcomes underscore the need for research methodologies integrating LEK to study human-nature interactions. In the YP, where tourism development and human overcrowding rapidly alter socio-cultural values and landscapes, these results are crucial. They aid conservation managers in comprehending the historical presence and current loss of sawfishes and their habitat, contributing to understanding the defaunation of megafauna over time. This knowledge is vital for sustaining tourism and fisheries' ecosystem services crucial to the YP communities' economies.

Session VIII - Patterns of ocean use and impacts

Quantifying historical changes in kelp Forests: Insights from 19th-century admiralty charts in Tasmania

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Historically, underwater forests of kelp dominated subtidal rocky reefs in temperate and subpolar regions globally. At present, these ecosystems are experiencing unprecedented levels of decline due to physical, biological, and anthropogenic factors, including accelerated climate change, large-scale oceanographic current alterations, marine species distribution shifts, and overfishing. In Australia, giant kelp forests have been classified as an 'endangered marine community type' under the Federal Environment Protection and Biodiversity Act since 2012 due to an alarming rate of decline over the past few decades. Given the ecological and social importance of these forests as ecosystem services providers, it is necessary to understand the magnitude of change to create accurate recovery targets for these ecosystems at risk. Using admiralty charts from the 19th century, this research seeks to quantify the historical extent of kelp forest along five sites on the east coast of Tasmania, comparing past distributions with modern kelp surveys (1953, 1986, 1999, 2019), and determine areas of kelp forest persistence over the past century. Admiralty charts present an opportunity to identify the extent and distribution of coastal habitats at high-spatial resolution and help create ecosystem baselines from which to inform habitat management and restoration efforts.

Cod Chronicles: A Comprehensive Reconstruction of the Newfoundland Cod Fishery (1508-2021).

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2. Trinity Centre for Environmental Humanities, Trinity College Dublin.

For half a millennium, the waters off Newfoundland and Labrador in Eastern Canada supported the single-largest fishery in human history. Fishers from across the world travelled to exploit vast stocks of North Atlantic cod (*Gadus morhua*), but after hundreds of years of continuous commercial exploitation, the fishery collapsed in 1993 and has been under a moratorium ever since. Over the last thirty years, fisheries scientists and historians have debated the role of long-term exploitation in the fisheries' collapse, but a lack of accurate historical catch data has hampered these discussions. This presentation introduces a groundbreaking new reconstruction of historical cod catches in Newfoundland from 1508 to 2021. This dataset is the longest, most comprehensive, and accurate reconstruction created to date and serves as a crucial tool for unravelling the complex dynamics of the fishery's rise and fall. This data illuminates the historical trajectories of diverse fishing fleets, maps the evolving spatial dimensions of the fishery, and provides catch-per-unit effort data across multiple centuries. By revealing the historical scale of this once-thriving fishery, we aim to understand the long-term human impact on marine ecosystems and show that the roots of collapse lie far before the extent of current scientific data.

Historical ecology of the Pacific cod: Catch reconstruction and drivers of decline in a management context

Loren McClenachan[1],Karoline Moore[1], Kai Muir[1]

1. University of Victoria

In the Gulf of Alaska, a series of marine heat waves in the 2010s severely impacted Pacific cod (*Gadus macrocephalus*), the effect of which depleted biomass to the lowest abundance ever recorded and led to the fishery's closure in 2020. While the Pacific cod fishery is currently the second largest fishery in Alaska and is considered to be well managed, this collapse may have precedents in history. Traditional knowledge holders refer to Pacific cod as "the fish that go," which may be a reference to past periods of decline. In recent history, the 1930s is a period of reported decline in the fishery, and understanding the change that happened in this time period may provide insight into long-term dynamics of Pacific cod. This talk (a) reports on a fisheries catch reconstruction of Pacific cod (1863-1977) which assesses the degree to which the fishery declined in the 1930s, (b) evaluates possible social and ecological drivers of that decline, (c) places these historical dynamics into a modern management context. This historical archival work is part of a larger collaborative project involving historians, anthropologists, archaeologists, and managers, aiming to understand long-term dynamics of Pacific cod and the ways in which diverse types of historical information can be help to improve modern fisheries management.

Thursday

KEYNOTE

The Beach as Archive: contemplating Australian history in landscape and culture

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The Beach is both an idea and a place in Australian history. It figures in Indigenous archives: middens and rock art lacing Australia's coastline reveal thousands of years of occupation and use, oral histories reach back to the beach's earliest history, providing astonishing accounts of the inundation that marked the end of the last ice age. It was the site of the first Asian and European encounters with this continent and its First Peoples, and episodes of contact, cross-cultural exchange and violence are a vital moment of its history. It has been central to Australian settler-colonial history, representing cultural belonging, and attachment as well as contest and exclusion. The beach is also a vast natural archive in its own right. In addition to its extensive human history, the stories of changing sands, tides, and storm surges, as well as beach worms, rock pools and nesting birds, all figure in the beach's life-story and form a vital piece of its history. The question of how to bring together the human/cultural and more-than-human history of 'the beach' forms the prompt for this paper, which explores environmental historical method using the place of the beach in Australian history.

Session IX – Evolving use of marine ecoscapes

Heritage, loss and precarity: taking a more-than-human approach to change within British fishing communities

Melissa Thomas[1]

University of York

As an island nation, Britain has utilised the sea as a resource throughout its history. From the nineteenth century onwards an industrial fishing industry developed which led to the growth of coastal communities, provided employment and created a distinct way of life; yet, simultaneously, it cost the lives of fishers, depleted marine species, and altered ecosystems. Taking Britain's fishing heritage as its focus, this presentation will seek to explore two facets of the relationship through time between British fishing communities and the sea. Firstly, it will use archival oral history, policy and contemporary case studies in England and Scotland to seek to answer the question: how have loss, precarity and change impacted the sense of identity in fishing communities throughout the period of commercialised fishing over the past two hundred years? Secondly, it will demonstrate the potential for a multispecies, more-than-human approach to help us learn about the consequences of change upon fish and fishing communities. Through the lens of emotional heritage, it will suggest that utilising memory narratives can provide insight into the ways in which the natural environment, marine species and humans affect one another in an entangled maritime assemblage.

How to provide scientific knowledge and international cooperation into an autocratic system of public decision? The Portuguese scientific structure for maritime fisheries after the second World War (1945-1974)

Álvaro Garrido[1]

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International maritime historiography has made it clear that, after the Second World War, maritime fisheries experienced huge growth. However, this trend was followed by scientific diagnoses of situations of scarcity and overfishing of various species. The Law of the Sea soon incorporated several restrictions on fishing rights and began a process of "territorialization". Following the trend of post-war international relations and the first tensions of the Cold War, Atlantic fisheries entered an era of intense competition, but also of international co-operation. At the time, Portugal was living under a dictatorial regime whose model of maritime fisheries governance was still linked to the principles of the fascist autarchy of the inter-war period. With the naturalist heritage of the 19th century broken, public institutions dedicated to marine sciences were practically non-existent. Paradoxically, between 1948 and 1955, the Portuguese state created a set of advisory bodies in the field of marine biology and research applied to fisheries, and its diplomacy made room for a regular presence at international meetings and conferences. In the case of the Atlantic cod fisheries, these levels of participation and co-operation were surprising and coexisted with a protectionist political economy. Taking this case-study, we will discuss in what extent the political context has shaped fisheries governance institutions. We will discuss, also, the extent to which international co-operation has generated changes in public policy and social perceptions about the management of a fishery that is fundamental to supplying the domestic market. The research was based on archival research, secondary sources and interviews.

How coastal stories can help climate mitigation in Dublin Bay, Ireland

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Coastal TALES is a recently funded Belmont Forum project which investigates how stories of past practises can help coastal communities today to build resilience against the rapidly changing environment due to a climate crisis. Three coastal areas form the core of this project of which Dublin Bay in Ireland is one. Oral histories and historical maps will help identify practices of managing rising waters with coastal defence structures. Working closely with ECO-UNESCO we apply an intergenerational approach to transfer local and traditional knowledge. In a series of interactive workshops with local communities we uncover and identify opportunities to plan the reintroduction of natural coastal defences such as eelgrass meadows and native oyster reefs seeking a dialogue with local authorities and policymakers. Overlaying the workshop findings with historical/archival maps and modern/technical maps we develop a managerial toolkit for baselines providing a historical background and a pedagogical toolkit for schools at national level for the changing interface of Dublin Bay's biosphere. The team will thus co-produce new story maps and soundscapes for the overall project and support societal and communal planning processes to assist climate mitigation based on cultural and natural tangible and intangible coastal heritage of the wider Dublin Bay area.

Taken At The Flood: Submerged Pasts and Green Futures

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Governments around the world are increasingly turning to offshore renewable energy as a means of fulfilling pledges to cut carbon emissions. Many areas of the continental shelf being developed align with areas of strategic interest, not only for how past populations lived through and navigated changes in climate, environment and sea-levels, but for our understanding of prehistory in general. Yet, outside of chance discoveries, it has not yet proven possible to reliably prospect for submerged prehistoric archaeology on the continental shelf, and there are large parts of the seabed with no provisions in place for the protection or management of prehistoric underwater cultural heritage. Consequently, rapid development of the seabed poses a significant threat to submerged prehistoric archaeology, but also offers a unique opportunity. Datasets gathered through development have significant potential for archaeological use, but to capitalise on this, a closer working relationship between developer stakeholders and heritage professionals is necessary. Taken At The Flood seeks to redress this challenge within the southern North Sea, and demonstrate the potential for improved methods of archaeological prospection through collaboration with offshore industry, highlighting how these professions may help one another better understand our submerged past, while working towards a greener future.

Session X – Ocean perceptions, politics and policies 1

Learning legal lessons to advance ocean justice

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For millennia human societies have devised laws to manage conflicts, regulate ocean industries, to conserve marine species and areas, and to safeguard maritime heritage. Law is one of the most important tools that humans possess to regulate how we use, exploit and share our ocean environments, and to prevent, mitigate or control the associated environmental impacts. Lawmakers have created a complex system comprising the law of the sea, maritime law, marine environmental and pollution law, fisheries regulation and underwater cultural heritage law. In the process, however, this system has effectively separated ocean from land, living organisms from non-living resources, seabeds from shorelines, and surfaces from water columns. The exponential growth in human uses and destructive impacts on the marine environment serve to highlight that our current legal frameworks, whilst broad and nuanced, are failing to address the major challenges facing oceans today. This presentation paints a picture of the legal landscape of the sea illustrating how law has been developed and utilised across time and in different contexts. It also points to the significant work that remains to be done to create a more prospective, holistic and just legal response to arrest marine degradation and secure ocean health.

Ecological architecture and societal consequences of medieval and post medieval intertidal fisheries of Ireland and Britain

Paul Montgomery[1] and André Tavares[2]

1 Porto University Portugal

2 Faculty of Architecture of the University of Porto

This paper investigates the widespread use and development of intertidal fisheries and fish traps in Ireland and Britain during the late Medieval to Post-Medieval periods. The paper will examine the intertwined nature of marine resources extraction and architectural/cultural interactions that evolved around intertidal fisheries during the period. Fish traps represent a crucial part of our architectural tradition representing our interaction with our aquatic ecology. Exploitation of freshwater and marine resources was an important pillar within the economic and social structures of late medieval/Post-Medieval society, leading to a greater exploitation of resources, which had long term negative effects on many aquatic environments. During the medieval and post medieval period fish traps initially increased in importance, but later faded with the advent of the industrial revolution. The economic value of fisheries made them a tangible part of the political and social/religious interaction and conflict during this period. Their value to society intertwined the fisheries and the wider natural environment with the human cultural interactions defined by ownership, political control and colonization for societies emphasizing the importance of the marine resources in human society that was mirrored globally.

“Taking from the sea more than the sea can replace”: Fisheries Science and the British Colonial Fisheries Advisory Committee, 1943-1961

David Wilson[1]

1 University of Strathclyde

The Colonial Fisheries Advisory Committee (CFAC), operating between 1943 and 1961, focused on ‘optimising’ and ‘developing’ fisheries throughout the British empire. CFAC concentrated on advancing research into fish biology and stock health within waters under colonial control while encouraging a programme of technology transfer surrounding gears, processing tools, and watercraft. Crucially, CFAC was instituted at a time when the major principles and approaches of fisheries science developed and became embedded within Western-oriented fisheries management regimes. This centred on attaining an optimum yield—where ‘optimum’ meant optimum long-term economic potential—by maximising yields without causing stocks to decline. From the colonial perspective, the scene was set whereby the idea of an optimum yield provided the groundwork for fisheries development programmes based on scientific research and assumptions of centralised control over natural resources. This paper will explore the major principles shaping CFAC’s vision, demonstrating how fisheries science and post-war colonial development converged in this blueprint to exploit and control marine resources. The paper will draw from case studies, particularly surrounding African fisheries, to demonstrate the trajectories and repercussions of this blueprint in practice as fishers, coastal leaders, and colonial officials responded to management interventions according to their own interests and observations.

The Bay of Porto Paone: the First "Tiny Underwater Nature Reserve" in the Gulf of Naples (1960-1966)

Alessandra Passariello[1]

1 Stazione Zoologica Anton Dohrn

From 1960 to 1966, the Bay of Porto Paone, a volcanic crater located on the islet of Nisida, in the Gulf of Naples, was home to the first "tiny underwater nature reserve" in the south Tyrrhenian Sea. The concession of the stretch of water was requested by the Stazione Zoologica di Napoli, a marine biological institution which aimed at strengthening its international visibility as a place for field ecological research. The establishment of the "underwater reserve" made it possible to collect a huge amount of data on the fauna and flora of the Bay and on the occurrence and relative extension of typical marine biocoenoses such as for examples Posidonia meadows and pre-coralligenous assemblages. The data then collected were charted on biocoenotic maps and either published in scientific journals or stored in unpublished grey literature. In the last 60 years, published data were variously used for the purpose of baselines studies by research teams working on benthic ecology, marine taxonomy and habitat conservation/restoration. My aim is to show how information emerging from the analysis of unpublished archival sources and dealing with the way data were acquired (instruments, methods and protocols, experimental plans) can support contemporary scientists in establishing reliable baselines.

Culinary Adaptation to Marine Species Declines: a Case Study of the Eastern Oyster

Emelyn Rude[1]

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This paper explores how American eaters adapted to the gradual collapse of oyster populations across the United States in the early twentieth century. One of the primary changes they made was substituting shrimp for oysters on various occasions and in myriad recipes. This transition was largely driven by Gulf Coast oyster packers themselves, who sought out new seafood products to process using their existing infrastructure. Shrimp, however, was virtually unknown to the American consumer at this time, which meant that the industry needed to create new cultural associations with the ingredient. In this example, Creole cuisine, both in practice and in the collective imagination, was central to consumer acceptance of shrimp. As local shrimp catches grew, so too did the general sense that shrimp, an ingredient largely unique to the Gulf, could be used to sell the city of New Orleans as a tourist destination. As shrimp subsequently spread throughout the country, it was almost always accompanied by a real or manufactured connection to Creole culture. Eventually, this connection transformed the cooking of the Big Easy itself and made this one aspect of New Orleans's diverse culinary culture into the defining characteristic of Creole cuisine.

Icelandic fisheries making waves in history

Hreiðar Þór Valtýsson[1]

1 University of Akureyri

The old Icelandic rowboat fisheries were largely unchanged from early on until the 19th century, in some places even into the 20th century, although baited longlines or gillnets were often used by then instead of handlines. There are several historical records available that provide information on catch rates (CPUE), the number of boats in operation, and exports from these fisheries dating back to 1604, although there are significant gaps in the data. These records are being used to examine whether there have been any consistent patterns of change in these fisheries over time, possibly related to climate change. An initial analysis of the data has revealed evidence of regular fluctuations occurring in periodic waves of 11, 19, 29, and 55 years, lasting until the mid-19th century.

Speed talks

An oceanographical affair: The Strait of Gibraltar region and the Portuguese research vessel 'Albacora' in the international scientific framework (1925-1940)

Pier Luigi Pireddu[1]

1 Faculty of Science, University of Lisbon (FCUL) – Department of History and Philosophy of Science

The article presents the oceanographic research carried out with the Portuguese vessel Albacora, owned by the Vasco da Gama Aquarium, in the years from 1925 to 1940. During this fifteen-year period, several expeditions were completed, with national and international impact. This scientific endeavor is presented by providing an overview of the debate and the main oceanographic results of the first half of the 20th century, emphasizing a close collaboration between the Scandinavian countries and the Portuguese scientific community, with Alfredo M. Ramalho as a pivotal figure. The work of the Albacora is explored in detail concerning the Strait of Gibraltar region. This area had already been the subject of analysis and was further explored with the study of the Portuguese oceanographic vessel as part of a research program proposed by ICES. An issue that, in turn, finds its place in an Iberian context and uncovers further sources of debate along the Spain-Portugal axis, also illustrating historically the importance that this region has played in the development of knowledge related to the phenomenon of ocean circulation.

The establishment of coastal fisheries management in 18th century France

Bernard Allaire[1]

1 Trinity College Dublin

Early modern France experienced numerous episodes of overfishing which greatly affected its coastal and littoral fisheries. If since the 16th century, naval ordinances had set limits on the activities of fishermen at sea and on the beaches, it was not until the beginning of the 18th century that the authorities seriously and continuously addressed what they then called "the sterility of the sea". It was by relying on the admiralties and the draft officers that a department was established in the 1720s responsible for supervising this maritime activity central to the economy of the kingdom. The implementation of this new system was preceded by a major investigation led by the French Fisheries Controller François Le Masson du Parc. By corresponding with local representatives and personally visiting towns and villages on the coast he undertook a large census of all sailors, boats, nets, fishing parks and equipment to verify their compliance with the maritime legislation. This survey will serve, among other things, as a basis for establishing initial reflections on the links between the protection of coastal areas and fish reproduction.

The role of museums and collections in analysing the past and opening a conversation about how to include sustainability in the museum world and exhibitions

Charlotte Jarvis[1]

1 Het Scheepvaartmuseum

Working at a museum provides a unique opportunity and lens in which to view the past. Throughout our exhibitions we strive to include this in the material covered and as we plan new projects, we ask ourselves how to bring the topic of maritime historical ecology into our stories. How do we take our currently collection, with journals, logbooks, and other primary sources, and use them to look to past ecology. For example, in a new Atlantic World exhibition, a key theme is the transformative power of the Atlantic World and the exchange. Especially on the Americas and the ecological populations there. We look at the practice of fishing and whaling and how Europeans left a stamp on the New World. It also invites conversations about how we, as a museum, create our exhibitions today. Instead of bringing in objects from abroad, with a high carbon footprint to do so, we want to include digital representatives and open a conversation with the visitors about how museums can be more climate friendly. Museums can bring a multidisciplinary perspective on the issues discussed at Oceans Past X.

Session XI – Historical perspectives on human-ocean interactions

Fisheries restricted areas in biodiversity conservation: The role of the historical context

Guðbjörg Ásta Ólafsdóttir[1]

1 University of Iceland

Other effective conservation measures (OECMs) recognize that various forms of management actions can contribute to biodiversity protection. The concept gained prominence following the COP15 agreement to protect 30% of seas by 2030. Fisheries restricted areas (FRA) are commonly used technical measures in fisheries management but have received recent interest as candidates for OECMs. FRA have a long history in Iceland, the earliest examples include gillnetting restrictions in 1885. Many have a complex historical background, relating to national or international conflicts of interests. Considering the extent of FRA in Icelandic waters and their relatively robust governance, there is interest in reviewing these actions for biodiversity conservation. Expert opinions differ on the value of reporting vague or under-researched areas as OECMs, but the perception of fishers has received less attention. Lack of stakeholder support is likely to increase the need for regulation, and thereby, the cost of patrolling the waters, enforcing rules and administrative sanctions. In the current paper I examined expert and stakeholder opinions on FRAs for biodiversity conservation and how perceptions relate to the historical context of these actions. The results highlight that understanding the historical background of resource use is essential as government moves forward to meet conservation goals.

The Little Ice Age in the Gulf of Alaska: Implications and Uncertainties in the Relationship between Climate Change, Fisheries Ecology, and Resilient Indigenous Economies

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1 University of Washington

2 University of Alaska - Fairbanks

3 SUNY-Cortland

Recent syntheses of late Holocene human-environmental dynamics in the Gulf of Alaska disagree on the interpretation of paleo-proxy evidence in ways that limit our understanding of the past and our ability to draw lessons for contemporary and future community planning, policy and management. A core source of confusion is the interpretation of salmon population trends from Kodiak Island lake cores generated by Bruce Finney more than two decades ago. Additional lines of paleoecological and historical evidence are needed to resolve the ambiguity. In this paper, we zero in on the interpretive disagreements and explore other evidential sources that might help to resolve it. Clarifying the climate-ecology dynamics in this region is essential to understand the significance of historical climate changes to Indigenous fisheries management and community resilience before and following the incursion of colonial control and interference starting 250 years ago.

A historical collection enabled to detect the impacts of intertidal mollusc harvesting in Inhaca Island, southern Mozambique

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Most of the data on the human exploitation of the oceans comes from developed countries, generally located in the northern hemisphere and with a long tradition of marine science studies and ample research infrastructure. In contrast, less is known from countries in the Global South despite large parts of the coastal population still fish and harvest invertebrates as a mean of subsistence. Here, we focused on the intertidal mollusc populations of Inhaca Island, southern Mozambique, subject to ample collecting by local communities mostly for food, bait and, less, to sustain a small-scale shell trading business. We used shell size as a proxy of impact on mollusc populations and compared size distributions of modern populations with the unique historical baseline of the collection held at the Marine Biological Station of Inhaca Island, largely assembled between the 1960s to 1980s. Our preliminary results showed a marked reduction in maximum and median body size ocurred for the six species exploited as food (*Modiolus philippinarum*, *Pinctada capensis*, *Terebralia palustris*, *Polinices mammilla*, *Pleuroploca trapezium* and *Chicoreus ramosus*) while minor differences can be noted for seven species from the families Cypraeidae and Conidae, potentially targeted by the shell trade.

The UK's expanding global reach for seafood, 1900-2020

Zoe Heard[1], Callum M. Roberts[1] and Ruth H. Thurstan[1]

1 Centre for Ecology and Conservation, University of Exeter, Penryn Campus, Cornwall

UK fisheries sectors were curtailed in the latter part of the 20th century as a result of fish stock overexploitation, regulatory reforms and the establishment of Exclusive Economic Zones. This led to declines in domestic landings and a growing dependence on the international seafood trade-network. I compile archival UK seafood import data over a 120-year period to track the evolution of the UK's global reach for seafood products, and assess the potential social-ecological repercussions of this demand. The volume of seafood imports significantly increased by 6.4-fold from 1900 to 2020, overtaking domestic landings in 1985, with the species composition of these imports reflecting the restricted palette of UK consumers and agri/aquaculture industry demands. The number of reported exporting countries increased from five to eighty-nine over the time-series. Lengthening supply chains have led to rising freight carbon emissions as seafood imports are transported 18% further on average, from 3-thousand kilometres (1900) to 3.5-thousand kilometres (2020), to reach UK markets. Furthermore, international trade has allowed fishing pressure to be exported to new geographical regions, leading to serially depleted stocks and the degradation of marine ecosystems across the world.

Time-travelling with Atlantic cod: A modelling approach to historical distribution in Newfoundland

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This paper presents preliminary results on how biology, ecosystems, and fisheries have shaped the historical (1815–1992) distribution of Atlantic cod (Gadus morhua) in Newfoundland (Canada). The work has been developed within the scope of the "Fishing Architecture" research project, which explores the historical continuum between fish and coastal architecture. This relationship is believed to be modulated by the morpho- and eco-physiological characteristics of fish. Our approach involves developing, calibrating, and validating a habitat-suitable model, using Maximum Entropy (MaxEnt). This model computed the maximum entropy distribution of abiotic (bathymetry, water temperature, salinity, nutrients) and biotic (phytoplankton, prey distribution) descriptors over the binary data (presence/absence) of cod, gathered from publicly available databases. Afterwards, we mapped the most suitable areas for cod presence. To assess the model's performance and uncertainties, we ran a global sensitivity analysis, using the GSAT package. The model results were further explored by overlaying the logbook routes of Portuguese cod-fishing vessels to Newfoundland (discrete data between 1840–1950), to understand the relative impact of this overseas fishery. The research complements previous approaches to understanding the breakdown of the cod population and provides a tool to assess the relationship between terrestrial constructions to support fisheries and marine fish populations.

Acclimatization of fish species across the Soviet Union: history and consequences for neighbouring countries

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Invasive species significantly contribute to human-induced transformations of aquatic ecosystems. A large-scale program of introduction (acclimatization) of new species started in the USSR in the 1960s. This acclimatization program formed part of the Soviet strategy to boost biological productivity. This strategy was partly driven by the establishment of national economic zones, which led to reduced maritime harvests. Prominent examples of the acclimatization include the introduction of Far Eastern species such as Pink Salmon in the White Sea and Kamchatka Red King Crab in the Barents Sea. These species eventually migrated towards Western Europe and currently cause problems in Norway and Finland. Numerous species, primarily from the Baltic and Far Eastern seas, were introduced into inland waters of Kazakhstan: the Caspian Sea, the Sea of Aral, and Lake Balkhash. Furthermore, the USSR carried out multiple species introductions in numerous reservoirs created by its extensive dam-building projects, which had varied impacts on local ecosystems. The introduction of fish species to Lake Balkhash significantly increased commercial catch, but it also led to a drastic decline in native species. Analysis of these cases of aquatic organism acclimatization provides valuable insights into the mechanisms of anthropogenic changes in aquatic ecosystems

Friday 28th June

KEYNOTE

Marine functional connectivity through the ages: geological and historical perspectives

Bryony A. Caswell*[1], Konstantina Agiadi[2]*, Rita Almeida[3], Ali Becheker[4], Andreu Blanco[5], Cristina Brito[6], Manuel Jesús León-Cobo[7], Ellie-Mae E. Cook[2], Federica Costantini[8], Merve Karakuş[9], Fabien Leprieur[10], Cataixa López[11], Lucía López-López[12], Aaron O'Dea[13, 14], Sven Pallacks[15], Irene Rabanal[12], Lotta Schultz[16], Susanne E. Tanner[3,17], Tatiana Theodoropoulou[18], Ruth H. Thurstan[19], Nina Vieira[6], Audrey M. Darnaude[10]

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Marine Functional Connectivity (MFC) refers to all of the unimpeded flows of matter, genes and energy caused by the movements of marine organisms, which occur over a range of temporal and spatial scales, and so MFC is a dynamic, constantly evolving global ecological process. Climate, palaeogeography, ocean circulation, biogeochemical cycles, the adaptation and evolution of marine organisms and human activities control MFC over the longer term. Geological and historical records describe changes in the distributions, life histories and migration of species, and so may provide valuable baselines for deciphering long-term MFC trends and variability. We explore the links between the long-term drivers and MFC processes, as well as the diverse archives that can be used to study them, including the sedimentary record, biogeochemical proxies, fossil assemblages, sclerochronological archives, genetic data, zooarchaeological remains, archaeological artefacts and historical sources. We consider what each might tell us about MFC, the biases and limitations, and the opportunities for future research on MFC over the long term. We demonstrate how, despite differences in norms and limitations between disciplines, valuable data on ecological and societal change can be extracted from "geohistory" and used to understand the evolution of MFC over time.

Session XII – Insights from Molecular and Isotopic Studies II

The Once and Future Fish: Assessing 1200 years of Atlantic herring exploitation in the waters around the UK and Ireland using ancient biomolecular techniques

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Herring population dynamics are characterized by dramatic shifts in abundance, and there has been extensive debate over the influence of historical overfishing and climatic forcing on herring demography in the North Sea. The North Sea autumn-spawning herring (NSAS) has supported coastal and pelagic fisheries for well over a thousand years. Indeed, the sudden dominance of herring bones in English archaeological sites around 1000 AD has led researchers to propose the "Fish Event Horizon". The NSAS historically supported highly profitable fisheries, such as the Dutch Republic and the Bohuslän "herring periods." Today, herring face warmer seas and a dramatically altered Atlantic Multidecadal Oscillation associated with reductions in recruitment. At the same time, continued exploitation of mixed herring stocks (e.g., during migration) complicates sustainable management. To provide better tools for managing stocks as biological populations, researchers have proposed using genetic assignment tests for mixed-stock analysis. Yet, it is unclear whether these tools are even applicable over long time-scales. Here, we use ancient molecular and genomic techniques to address several outstanding questions: 1) Have herring responded to past climate change? 2) Can genetic assignment tools work over the long-term? 3) Has a millennium of exploitation altered herring ecology in the North Sea?

Population structure of *Dugong dugon* across the Indo-Pacific revealed by historical mitogenomes

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Sirenia, an iconic marine taxon with a tropical and sub-tropical worldwide distribution, face an uncertain future. All species are designated 'Vulnerable' to extinction by the IUCN. Nonetheless, a comprehensive understanding of geographic structuring across the global range is lacking, impeding our ability to highlight particularly vulnerable populations for conservation priority. Here, we use ancient DNA to investigate dugong (*Dugong dugon*) population structure, analysing 56 mitogenomes from specimens comprising the known historic range. Our results reveal geographically structured and distinct monophyletic clades characterised by contrasting evolutionary histories. We observe deep-rooted and divergent lineages in the East (Indo-Pacific) and obtain new evidence for the relatively recent dispersal of dugongs into the western Indian Ocean. All populations are significantly differentiated from each other with western populations having ~10-fold lower levels of genetic variation than eastern Indo-Pacific populations. Additionally, we find a significant temporal loss of genetic diversity in western Indian Ocean dugongs since the mid-20th century, as well as a decline in population size beginning ~1,000 years ago. Our results add to the growing body of evidence that dugong populations are becoming ever more susceptible to ongoing human action and global climate change.

Ancient Echoes in Modern Seas: Bioarchaeological Clues for Sea Turtle Habitat Conservation

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In the pursuit of the second official goal of the UN Ocean Decade (2021-2030) to 'Protect and restore ecosystems and biodiversity,' we present a study amalgamating bioarchaeology and contemporary data. Focused on the eastern Mediterranean, our research utilises palaeoproteomics, stable isotope analysis ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$), and satellite tracking technology to identify vulnerable sea turtle habitats over five millennia. Our analysis of archaeological green turtle (*Chelonia mydas*) bones unveils generational site fidelity to North-African seagrass meadows, emphasising habitat significance beyond the Anthropocene. Combining these long-term insights with contemporary data, we underscore the importance of protecting Egyptian and West-Libyan coastal seagrass beds for both species conservation and the preservation of ancient heritage. In a complementary investigation, we delve into two archaeological sea turtle finds in Northern European archaeology. Applying ZooMS and stable isotope analysis to specimens from Schagen and Leeuwarden, Netherlands, we identify a loggerhead turtle (*Caretta caretta*) and a green turtle, respectively. Isotope provenancing suggests the likely import of the Leeuwarden specimen during a period when sea turtle soup was fashionable. This interdisciplinary approach illustrates how biomolecular tools can aid in understanding the historical trade of sea turtles, providing a toolkit to better interpret past ecology and exploitation.

The cod aquatic: investigating ecosystem change over the last 1000y in north-eastern Scotland using zooarchaeology and compound specific isotopic analysis (CSIA) on cod remains

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Fish remains are common finds at archaeological sites in north-eastern Scotland, and can be used to infer local and regional patterns of subsistence, fishing technologies and proto-commercialisation, food preservation, and dietary choice. The introduction of industrial fishing methods in the 19th century, coupled with increased fishing effort, led to the decline visible today, but it is unclear whether traditional, lower-intensity fishing in previous centuries had already had an impact on fish stocks. Here we use two methods to investigate this question. Firstly, traditional zooarchaeological methods allow us to investigate changing species and size profiles within human catches over the past millennium. We will show a change from open water fishing for very large fish during the Late Norse period and the MCA, towards inshore fishing for smaller, younger cod family fish correlating with the changing conditions of the LIA. Secondly, we apply compound specific nitrogen isotope analysis (CSIA) to collagen extracted from well-dated archaeological remains to explore changes within Atlantic cod populations. We show how this approach is able to estimate trophic level at much higher precision than bulk $\delta^{15}N$ alone by measuring the difference between source and trophic amino acids. Trophic level estimations are compared on the one hand with paleoclimate data to investigate variation in ocean productivity corresponding with documented climatic events, particularly the MCA and the LIA, and on the other with the chronology of anthropogenic exploitation and impact documented from the zooarchaeological evidence. We show how a combination of zooarchaeology and CSIA can potentially offer a novel approach for disentangling anthropogenic and environmental impacts on fish stocks.

Session: Reconstructing past marine communities and ecosystems

Tracing prehistoric oyster exploitation in NW Ireland from the fifth to third millennia BC

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Coastal shell middens are a valuable cultural heritage resource with the potential to shed light on many aspects of human interaction with coastal environments across time. Over 500 coastal shell midden sites are recorded along the c. 7500km of the Irish coastline, with dates spanning from the Mesolithic to relatively recent times. Unfortunately, a significant number of these sites are threatened by a combination of natural processes — such as sea-level rise, coastal erosion, and increased storm surges — as well as human activities, including visitor footfall, unauthorised removal of archaeological materials, agricultural practices, and encroaching development. Here we describe a recent radiocarbon dating programme which targeted six eroding coastal shell midden sites in County Sligo, NW Ireland. The results of this study point to persistent exploitation of the marine environment between the Later Mesolithic and Late Neolithic in this region, across the transition from hunting and gathering subsistence to sedentary farming lifeways. These recently obtained dates shed light on the potential influence of climate and environmental shifts on prehistoric marine resource utilisation in the region. Additionally, they play a crucial role in addressing the loss of significant archaeological data due to coastal erosion and the escalating effects of modern climate change.

Coastal salt marshes in early modern England and Wales

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This paper considers the nature and use of coastal salt marshes in early modern England and Wales. Coastal salt marshes are dynamic habitats that are strongly influenced by regular saltwater inundation, and provide various niches for salt-tolerant flora, wading birds and wildfowl, grazing animals and human activity. During the later sixteenth and seventeenth centuries, these land- and sea-scapes came under increasing pressure and scrutiny as new economic and legal contexts made them sites of legal conflict and schemes for economic improvement. This paper charts the changing face of coastal salt marshes in early modern England and Wales through the voluminous litigation that these disputes produced. Legal cases enlisted local salt marsh users to provide oral testimony about the history and nature of the marshes. Those recollections tell us much about the changing nature of the English and Welsh coastline, as well as about how salt marshes were used and perceived in a time of economic and legal change.

The fishing crisis and its local effects

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After the end of the Second World War, an expansion of fishing's opportunities to catch ever greater quantities of fish began. This of course affected the stocks in the sea, but the new stage in the history of fishing also meant major changes for the coastal population. Our presentation is about a micro-example of how one of the most successful fishing communities along the Bohuslän coast, with a state-of-the-art fishing fleet, could disappear completely in just a few years. Around this community, Åstol, there are many modern myths about why the fishing industry disappeared. We dispel these myths and present a partially different picture of how the prerequisites for fishing changed, how the economic conditions changed, and how the actions of the Swedish and other Nordic states affected the small island with the large fishing fleet.

Reconstructing the assemblage of large pelagic fishes in the Northern Adriatic Sea

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The Adriatic Sea is possibly the most overexploited basin of the Mediterranean Sea and in this specific area a large amount of data about the demersal species were collected in the second half of the 20th century, including data from scientific bottom trawl surveys. But targeted samplings on large pelagic fishes have never been made. Most of the large pelagics in the Mediterranean are increasingly rare nowadays and are probably regionally extinct in the Adriatic Sea. This work aims to reconstruct the historical occurrences of large pelagic species in the Adriatic Basin, through alternative data sources such as: naturalists' descriptions (n=20), local history books (n=2), fish markets landings (n=134), photos (n=1) and recreational fishing clubs archives (n=68). Using these data, a time series of the presence and absence of large pelagics, separated by year class (1800-2006), was created. The preliminary results highlight that some species, such *Sphyrna tudes* and S. *zygaena* are not recorded anymore nowadays. Furthermore, most of the remaining species of pelagics, previously common, showed a drastic decline after 2000. Despite some methodological limitation due to the use of unconventional sources, our work shows that large pelagics were present in the Adriatic and have consistently declined or disappeared. This work shows the importance of historical sources to understand how ecosystems changed over time and how to apply efficient management measures.

The world was our oyster: Records reveal the vast historical extent of European oyster reef ecosystems

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Biogenic reef ecosystems built by the European flat oyster (*Ostrea edulis*) were historically heavily exploited yet highly vulnerable to human activities. This has resulted in very few biogenic habitats remaining today. Rapidly growing international efforts to restore oyster reef habitat and their associated ecosystem benefits requires an understanding of what we have lost. Collating >1,600 records published over 350 years, we created a highly resolved (10km^2) map of historical oyster reef presence across its full biogeographic range, including documenting abundant reef habitats along the coasts of France, Denmark, Ireland and the United Kingdom. Areal extent data were available from just 26% of locations, yet totalled >1.7 million hectares (median reef size = 30ha, range 0.01 -

1,536,000ha), with 190 associated macrofauna species from 13 phyla described. Our analysis demonstrates that oyster reefswere once a dominant three-dimensional feature of European coastlines, with their loss pointing to a fundamental restructuring and ‘flattening’ of coastal and shallow-shelf seafloors. This unique empirical record demonstrates the highly degraded nature of European seas and provides key baseline context for international restoration commitments.